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Cover photo by Mark Madeo

Gordon
Mah Ung

JUST BUILD IT, BABY

THERE'S A MISTAKEN ASSUMPTION in the world of technology that PC enthusiasts are elitists, snobs, and that we sneer at anything less than a full super-tower rig that causes the lights to dim when it's switched on.

That's not true.

Sure, we like to push back a little against the inherent bias against us and give those with inferior hardware a tough time (see, kidding again) but the best thing about the PC community—the PC enthusiast community—is that we're completely inclusive. Wade into any gaming or PC forum as, say, a Mac or console user looking to build his or her first PC, and you'll get dozens of helpful answers on what parts to buy and encouragement to come back and ask more questions and, of course, to post a picture of the built machine or benchmark results when done. We want more people in our community because it's simply the best community to be in.

That's one of the primary reasons this month's cover story is dedicated to showing anyone and everyone how to build a PC. It's not aimed at the old salt whose hands are covered in scars from building PCs. Rather, we hope that this story will give the person who's maybe installed a video card or RAM but never put a whole box together the support they need to take the next step. So, PC enthusiast, read the article, hunt for the typos, pound your fist on the table because you disagree with a verdict, and then when you're done, pass this issue on to a friend or family member who you think is ready to enter the PC DIY community. You'll probably have to explain a step or three along the way but we really think this is just about they'll need.

For new builders, believe it or not, building the PC is the easiest part. The hardest part is actually picking the parts you want to go into your new rig. We can't tell you exactly what to buy for your system, as that depends on your needs and your budget, but we try to pour as much practical part-picking advice as we can into three pages, and arm you with some of the tools to get you through this step.

When you're done building, installing, and perhaps even overclocking your machine, pat yourself on the back—you've taken a big step on a what we hope will be a long journey in one of the most enjoyable aspects of technology still available to us all—building a PC.

Gordon Mah Ung is Maximum PC*'s Editor-in-Chief, senior hardware expert, and all-around muckraker.*

↘ submit your questions to: comments@maximumpc.com

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THE NEWS

Haswell-E: What We Know

Intel's "real" enthusiast chip is imminent

FOR PC ENTHUSIASTS looking for a summer CPU pick-me-up, Intel's Devil's Canyon chip proved to be more of a yawner than adrenaline boost, thanks to dashed hopes of 5GHz overclocks on air for all. Fortunately, performance addicts will get a second shot when Intel's Haswell-E finally gets its long-awaited reveal.

Intel essentially packages up the well-known Haswell cores in a new larger CPU to make up the company's first consumer eight-core CPU. Broad outlines of Intel's chip have been known for months, but the latest leaked details may indicate that Intel intends to push multi-threading capability to more mainstream pricing than ever before.

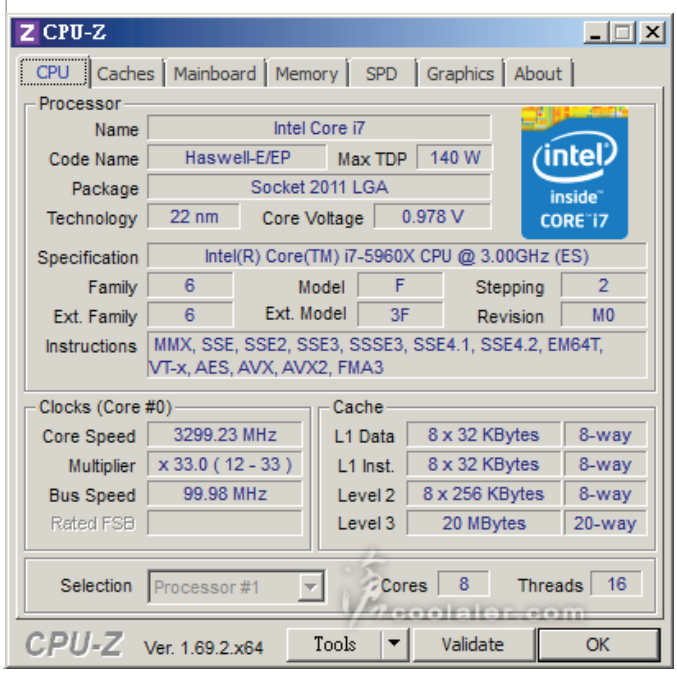
As always, Intel wouldn't comment on unreleased products, but leaks aplenty seem to be flowing—not all of them appear to be solid, though.

We've long known Haswell-E would have eight cores with Hyper-Threading, but a little more is apparent now. The top-end CPU appears to be predictably named the Core i7-5960X Extreme Edition and would come with a base clock speed of 3GHz and 20MB of L3 cache. The Core i7-5960X is expected to slot in at $999, but one online store slipped early pricing at closer to $1,100. The store, Shopbit.com, also priced out the two other expected Intel parts: the Core i7-5930K, and the Core i7-4820K at $631 and $425, respectively. The price "leak" by Shopbit.com is somewhat suspect, though. Even after the pricing details were reported widely on the Internet, the prices and model numbers remained. Vendors usually pull the details once they realize the products aren't released or are still under wraps.

Other details of the new chips seem more solid. The Core i7-5930K appears to be replacing the current six-core Core i7-4930K chip and will feature a base clock of 3.5GHz.

The most promising of the three may be the Core i7-5820K CPU though, which would replace the $323 Core i7-4820K. What isn't known is the price. The leaked price, though taken with a pound of salt, indicates the CPU may come in at $425. That breaks the $323 pricing Intel has used for the last two CPUs in this tier: The Core i7-4820K and the Core i7-3820K. Even so, the budget chip may come with a performance cost, if one report is accurate. Tech site ThePCEnthusiast.com reported that the Core i7-5820K may feature a hobbled PCIe configuration of one x16 and one x8, rather than two x16 PCIe slots. Like the leaked pricing, the info has a good chance of being wrong, as it breaks Intel's MO in how it declaws its CPUs. The company typically reduces cache size, turns off cores, removes Hyper-Threading, and uses other de-featuring techniques, including locking the CPUs to differentiate them. Reducing the number of PCIe lanes, especially on a platform intended to provide robust PCIe bandwidth, would be a new precedent and is unlikely.

One detail we do know to still be correct is the use of a new LGA2011-3 socket that is incompatible with current LGA2011 motherboards. Haswell-E is also confirmed to be the first consumer PC CPU to use a DDR4 memory controller. Full details won't be known until for another few weeks. But after being disappointed by Devil's Canyon, enthusiasts are hoping for a home run from Intel. **–GU**



Haswell-E information has seemingly sprung a leak in recent weeks, including this CPUID of a Haswell-E from Coolaler.com

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Seagate's 8TB HDDs

Put down your pathetic 6TB drive—Seagate says it has broken the 8TB barrier with a new enterprise-class 3.5-inch hard drive. Seagate officials say they have been quietly sending samples to customers for evaluation and expect to go into to full production soon. Seagate had previously hinted it would ship 8TB and 10TB drives this year, so the news isn't shocking. What isn't known is how the company is achieving the capacity. In its 6TB drives, Hitachi sealed units and filled them with helium so it could pack an unheard-of seven platters inside. Western Digital also just started shipping its own 6TB Red drives, as well. **–PL**

Dell Does BitCoin

BitCoin, the popular and controversial crypto-currency, can now be used to buy hardware through Dell. Dell, the third largest PC maker in the world, said it made the decision to start a pilot program for using BitCoin to offer its customers more choice and flexibility when buying a Dell computer. The company said for a short time, it would even give those who buy new Alienware computers a 10 percent discount (with a $150 limit) if they paid with BitCoin. Dell isn't the first tech company to take crypto currency a run—TigerDirect and Xidax have accepted BitCoin for several months. Earlier this year, Dell also accepted BitCoin payments for gift cards. **–SK**

Battlefield Hardline Delayed

Electronic Arts says it has delayed the release of *Battlefield Hardline* so that developer Visceral Games could work on the multiplayer aspects, improve the storyline, and increase stability. The company had planned to release the crime-thriller based on the *Battlefield 4* engine in October, but is now pushing it back until early 2015. EA and DICE both suffered the wrath of gamers for a host of problems when *Battlefield 4* launched, including crashing, network code issues, hitbox detection issues, and connectivity problems. Karl Magnus Troedsson of DICE said, "We decided that the right thing to do was to take more time to ensure *Hardline* is the best, most innovative *Battlefield* experience we can give to you, our fans." **–PL**

Tom Halfhill Fast Forward

WINDOWS 8 WORKAROUNDS

IN COMPUTING, "low power" often has an unfortunate double meaning: low power consumption, but also low performance. The economies required to reduce power consumption usually reduce performance in some way. All other things being equal, we don't expect a notebook processor to match a desktop processor's performance.

Next-generation low-power DRAM turns that compromise upside-down. The new LP-DDR4 standard is not only faster than the popular DDR3 standard for desktop memory, but it's also faster than the latest DDR4 DRAM. Indeed, LP-DDR4 is so fast that it could replace DDR4 in future desktop PCs, although this would require modifying the processors.

What's happening is further evidence of a trend I described last year, when a new image-sensor technology initially targeted smartphones instead of digital cameras. As mobile devices eclipse the sales of traditional platforms, they create more demand for lower-power technology and spur more innovation.

Higher demand usually drives down prices, too. Research firm DRAMeXchange expects more DRAM to go into smartphones and tablets than into PCs this year. If commodity prices tilt in favor of LP-DDR4 memory, it will likely spread to PCs.

LP-DDR4 uses several tricks to hold power consumption steady while doubling LP-DDR3's bandwidth. Whereas LP-DDR3 supports 1,600 to 2,133 million transfers per second, LP-DDR4 supports 3,200 to 4,266MT/sec. Chip bandwidth rises as high as 17GB/sec—twice as fast as LP-DDR3 and three times faster than DDR4. And LP-DDR4 uses about half as much energy per bit as DDR4.

To use LP-DDR4, however, the DRAM controllers in PC processors must change. Today, LP-DDR4 is designed for the multichip packages and stacked chips common in phones and tablets, whereas PC processors connect to external DIMM slots. Also, PCs usually have more DRAM than mobile devices. But production volumes and commodity pricing are powerful forces that could make LP-DDR4 an attractive alternative.

Tom Halfhill was formerly a senior editor for *Byte* magazine and is now an analyst for *Microprocessor Report*.

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Thomas McDonald Game Theory

BLACK AND WHITE AND A LITTLE RED

ALL VISUAL MEDIA has its black-and-white mode, from the moody use of shadow and light in classic film and film noir, to the black ink of the Chinese literati school and Asian calligraphy, and even the humble comic strip.

If games are to be considered a serious member of the visual arts, then they will need to come to grips with a wider range of visual expression, and that should include experimenting with monochrome. PC game visuals passed through their Hercules graphics card stage as quickly as possible, and nobody feels nostalgia for it like they do for 16-bit visuals.

Since the advent of color, few games have tried to explore black-and-white with any real creativity. Indeed, if there are any others than *MadWorld* and *Limbo*, I missed them.

Betrayer is an attempt to explore the potential of a wide-open outdoor colorless world. The game itself is good though flawed, but the black-and-white is undeniably moody and effective. *Betrayer*'s use of low- and high-contrast modes of seeing is extremely effective for creating two distinct worlds with two different types of threat. Even more effective is the sparing use of red for NPCs and important objects. These slashes of color are such a key element that playing the game in full-color mode is simply less effective.

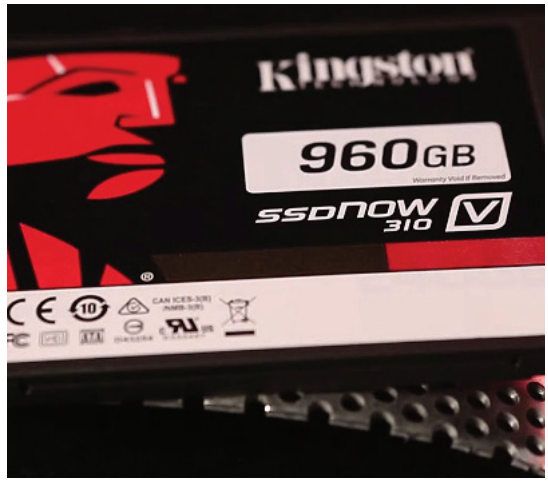
And there you have the problem: it can be played in color. It's really just an Unreal game with the color turned down, rather than one with an inherent sense of the demands of monochromatic visual design. Indeed, in order to properly see the world, you'll need to turn up the color just a bit.

I'm delighted that Blackpowder Games opted for this bold style, but it points to the ongoing challenges of expanding the expressive potential of game art. As indies embrace their 16-bit roots, they may also want to strike out for uncharted territory: game worlds without color.

Thomas L. McDonald is Editor-at-Large of *Games Magazine*.

Kingston's 960GB SSD

Kingston says it is will ship a 960GB version of its value V300 SSD series called the V310. The Kingston V310 will use a Phison 3108 controller and is rated to hit fairly pedestrian 450MB/s reads and 440MB/s writes. The drive comes with a three-year warranty, a 1 million hour MTBF rating, and an endurance expectancy of 2,728TB writes before giving up the ghost. Pricing of the drive was not disclosed, but most 1TB or near-1TB drives hover in the $400 range. **–PL**



Microsoft to Slash Up to 18,000 Jobs

Company CEO Satya Nadella wrote in an open letter to his employees that up to 18,000 jobs would be cut by next summer, noting that the "vast majority" of cut employees would be notified within the next six months. This will be the biggest round of layoffs in the company's 29-year history. He said that 12,500 layoffs would come from the Nokia Devices and Services division, which Microsoft purchased in September 2013 for $5 billion. Nokia already cut 24,500 jobs between February 2012 and the end of 2013, and had about 91,000 employees as this issue went to press. Nadella said that all workers affected by the cuts would receive a severance package, as well as job transition help. **–TM**

Tech Tragedies and Triumphs

A monthly snapshot of what's up and down in tech

TRIUMPHS

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TRAGEDIES

COMCAST CANCELLATION CONUNDRUM
Cable company rep becomes belligerent when customer attempts to cancel. Nice retention training you got there.

KIMMEL'S SMARTWATCH
Late-night TV host convinces some that his ancient Casio digital watch is a new Apple product, mainly by putting Apple's logo on it.

CANVAS FINGERPRINTING
Ad company figures out a way to track Web users that's difficult to block—EFF's Privacy Badger can fight it, though.

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Quinn Norton Byte Rights

AN INTERNET FAREWELL

SIX YEARS AGO, I introduced myself in *Maximum PC*'s new Byte Rights column with the "Fair Use Manifesto." At that time, digital rights was almost synonymous with copyright. Those issues, like DRM and DMCA abuses, haven't gone away, but so much else has happened since then.

We fought warrantless wiretapping and lost. (For now.) We fought COICA, SOPA, PIPA, and ACTA, and—amazingly enough—won. By 2011, it was clear all over the world that digital rights were human rights, and I expanded what I wrote about accordingly. Since 2013, we've been fighting every day for our privacy—sometimes from corporations, with tools like the EFF's Privacy Badger and HTTP Everywhere, and sometimes against the government surveillance plans revealed by Edward Snowden. Intellectual property is still digital rights too, from the shrinking public domain and the patent courts of Texas, to a trademark suit against a roller derby girl.

In our six years together, I have never missed an issue, and you have always given me wonderful feedback. I've gotten letters from prisoners, drinks from programmers, and tips from lawyers. It's been a roller coaster ride for me, and anyone who cares for digital rights and wants to see them protected in the world. It's been an honor and pleasure to chronicle them for you—complete with ninja jokes, Bond references, and UNIX commands.

My time as your columnist is done, but we still have much to do. We need to ensure net neutrality, improve security and privacy tools, stop the TPP, limit the NSA, and protect our freedom of expression from censors and copyright holders. The Internet, this amazing place we've built together, needs to be strengthened and protected before we hand it down to our children and their children: This is the job of our generation.

Thanks, so long, and see you on the tubes.

Quinn Norton writes about copyright for Wired News and other publications.

Nvidia Shield Tablet Unveiled

The Santa Clara–based hardware company launched its Shield Tablet this summer, which is a $299 8-inch Android Kitkat unit powered by Nvidia's new quad-core Tegra K1 chip, with a 1920x1200 screen, 2GB of RAM, 16GB of internal storage, an SD card slot, and 5MP front and rear cameras. The $60 controller for this device is sold separately and does not integrate a screen. However, the controller is not strictly necessary; we're told that you can use any controller that is compatible with Kitkat (plus the company intends to update the tablet to Android L when the time comes). Unfortunately, the unit uses micro-HDMI instead of MHL, so you can't charge and output to a TV at the same time.

Switching from a handheld system to a tablet-plus-controller may be disappointing for those who enjoyed the smaller form factor, but Nvidia tells us that the Shield Tablet is more like a cousin than a direct successor (hence it's not called Shield 2). They have also improved their streaming technology to the point where it can work over a wide-area network. In one scenario, you could be at a coffee shop and stream a game running on your PC at home. The Tegra K1 also has the same silicon as a GTX Titan, but with fewer streaming processors (192, in this case). Nvidia says that the GPU is at least on par with previous-generation consoles. This chip is 32-bit, but the company is already working on a dual-core 64-bit follow-up called "Denver." The unit comes in LTE 802.11n MIMO and LTE varieties. **–TM**

GTA V Coming to PC Soon

If you're like us, you've been hoping and waiting for Rockstar to release the fantastic *Red Dead Redemption* on the Windows platform. Unfortunately, there's no signs of that happening yet. However, it looks like the game developer is giving us a nice runner-up. Danish retailer Cool Shop posted a pre-order page with *Grand Theft Auto V*'s release date slated for November 2014, which would be a Friday, a customary day of the week to launch in Europe. The page was pulled and quickly replaced with the usual placeholder of December 31st. We're told that this version will have a better video editor and upgraded visuals. But no cowboys or horsies. **–TM**

Microsoft Clarifies on Windows 9

During the company's during fiscal fourth quarter earnings call, CEO Satya Nadella caused a bit of a stir when he said, "We will streamline the next version of Windows from three operating systems into one single converged operating system for screens of all sizes." However, he was not talking about a single SKU to rule them all. Later, he clarified: There would be a unified ecosystem so that all Windows devices, from the Xbox One to the Nokia Lumia, could run the same program with minimal modification. However, there is still the issue of interface scaling, so we'll have to see how it shakes out. **–PL**

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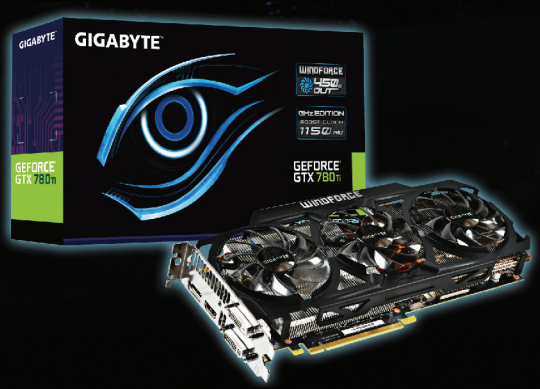


THE LIST

HOLLYWOOD'S SIX MOST EVIL TECH COMPANIES

6 WEYLAND YUTANI

Say what you will, at least Microsoft doesn't screw over its customers for a percentage like Wey-Yu.

5 CYBERDYNE SYSTEMS

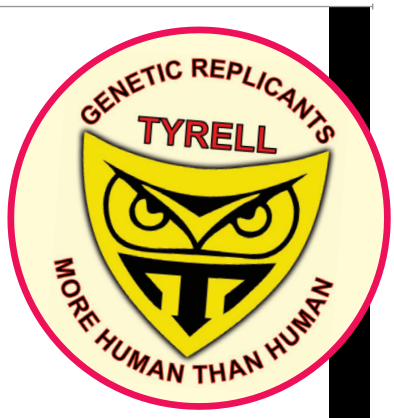
Cyberdyne Prime Accounts can't erase away that little thing called genocide.

4 OMNI CONSUMER PRODUCTS

Proof that privatization isn't always better.

3 TYRELL CORPORATION

What's more evil than a company that designs products that last only four years?



2 HYPERDYNE SYSTEMS

A full recall should have been issued for those twitchy 120-A/2 models far sooner.

1 UMBRELLA

When its t-Virus failed FDA approval this multi-national pharma company sold it as an herbal supplement.

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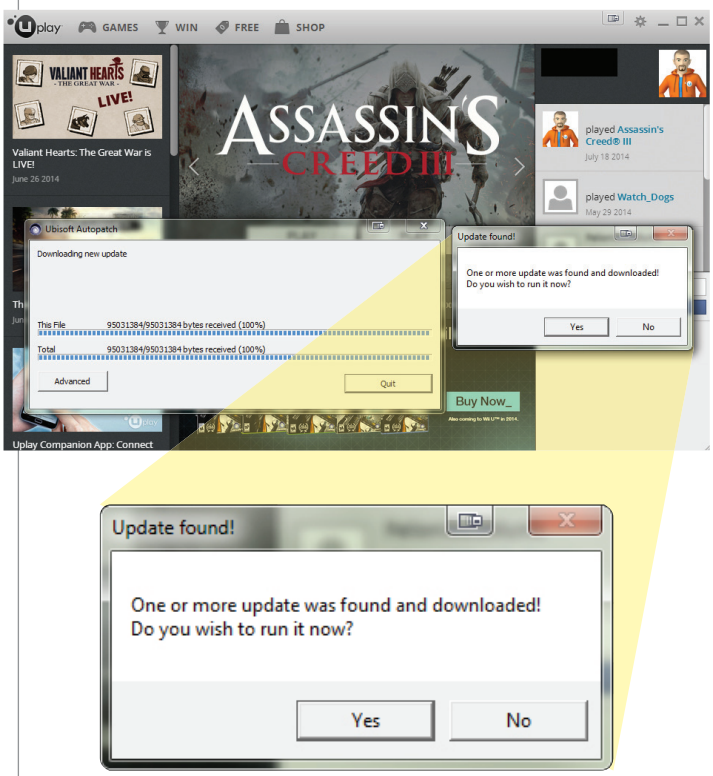
Work easy, play hard Windows 8

HEAD TO

BY TOM MCNAMARA

uPlay vs. Origin

In PC gaming, online stores have largely replaced retail. The major ones have their own software packages that manage downloads, instant messaging, and the actual shopping experience. Steam is the king of the hill, at least in terms of sheer popularity. But Ubisoft and Electronic Arts have created their own versions of it, complete with franchises like *Battlefield* and *Assassin's Creed* that can only be accessed through their walled gardens. So, let's determine who's No. 2 around here.



uPlay won't notify you of an available game patch until the next time you start the game.

ROUND 1

User Interface

When you double-click a game's desktop shortcut, uPlay steps in and gives you a launcher, so you have to start the game twice every time. Origin will go straight to the game, but loading the client defaults to the storefront instead of your library, and you'll get a pop-up window for current sales and special events. Thankfully, you can change Origin's behavior in its settings menus. You can also queue multiple game downloads. Origin can also tuck into the system tray and do its downloads in the background. Neither client has the option to create a game-specific desktop shortcut. You either create it during game installation, or you dig up the executable on your hard drive and create one manually. But Origin allows you to permanently hide games that you don't care about, which is something that Steam users have been requesting for years.

Winner: Origin

ROUND 2

Library

As this issue went to press, Ubisoft had about 60 games that required its uPlay service. When you buy one of its games through Steam, you download it from Valve's servers and log in to access it, but you still get redirected to uPlay's log-in and game launcher. Why would you bother with Steam at that point? Well, for some reason, uPlay's own content servers do not provide the fully patched version of the game. You must start, close, and restart the game for uPlay to detect and install each patch. EA has a couple of dozen games that require Origin. These can't be found on Steam, but you can get some Origin keys at other online stores like Amazon and Gamestop. This means that uPlay tends to have better price competition. uPlay sells non-Ubisoft games and even some Steam keys at times, so its service tends to have more buying options as well.

Winner: uPlay

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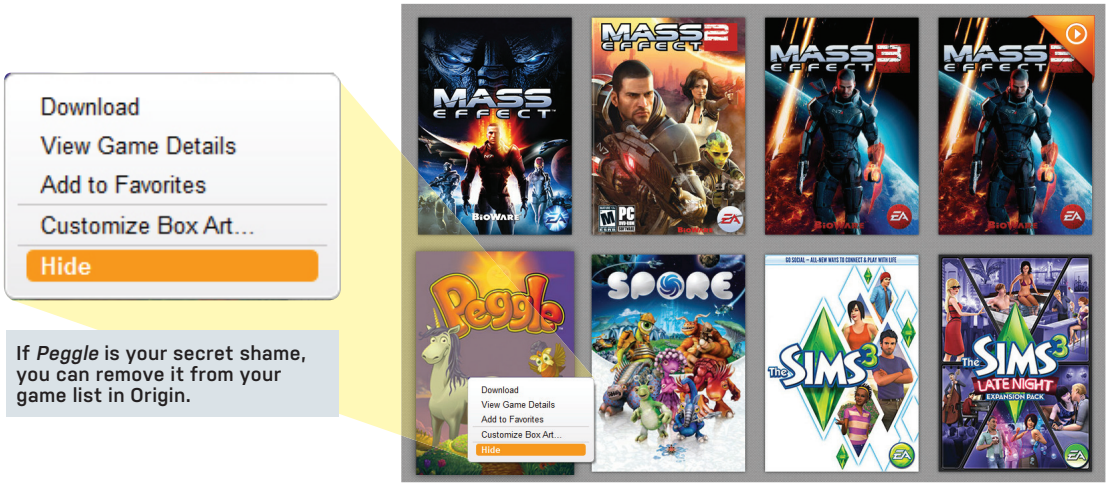
HEAD



ROUND 3

Features

Each client has its own version of a Steam overlay, plus achievements and cloud storage for save files. uPlay also allows you to launch in offline mode with most games, as long as you have logged in at least once before with your particular game to authenticate that purchase. Origin allows you to go into offline mode only after you have logged in. However, EA offers a seven-day money-back guarantee on titles that are both sold through Origin and published by EA, which shortens to 24 hours if you have launched the game. With uPlay, all sales are final. The Origin client also has a detailed grid to select friend activities that you do or don't want to be notified about. uPlay lets you limit the amount of bandwidth it uses, but you can't enter a specific number. Last but not least, Origin will accept Steam keys and provide you with the Origin version of that game.

Winner: Origin

ROUND 4

Community

These clients integrate their own user-communication platforms with instant messaging, friends lists, and in-game voice chat (during multiplayer). You can hook up both services to your Facebook account to quickly populate your list of peeps. Origin also throws in Xbox Live and PlayStation Network friend integration, though. And Origin has an invisible mode, so you can be online but look offline to your friends, if you're not feeling social. Origin also has a number of privacy settings that are completely absent from uPlay, such as hiding your profile from people who are not logged into the service, specifying what services people can use to find your profile, hiding just your achievement and Origin points while leaving the rest of the profile visible, and creating a list of users who can never see your online presence or profile even if they are logged in. Steam would lose the privacy settings contest, as well.

Winner: Origin

ROUND 5

Digital Rights Management

When uPlay launched in 2012, its games required an always-on Internet connection, and you had to log into its servers even when playing a purely single-player game. These restrictions are almost all gone now, but Ubisoft still uses SecuROM and Tages DRM in a few titles. These impose limits on the number of times you are allowed to install a game, or the number of computers you are allowed to install them on, or both. Some users have found these mechanisms invasive and error-prone. A number of older Origin games use SecuROM, as well. At some point in 2012, Origin transitioned to an authorization system based on just logging into the service. However, it has not completely abandoned always-on requirements, as we saw with the release of *Sim City* in March 2013. One year later, EA updated *Sim City* to allow offline play.

Winner: Origin

And the Winner Is...

Admittedly, uPlay is at a disadvantage because Origin has been around for a year longer. But EA has put a lot of resources into bringing its online store and client to within a stone's throw of Steam, the 800-pound gorilla here. And in some areas, it's already moved past Valve's client design. uPlay sometimes has better prices for its games, but **Origin** is ultimately the winner in our contest.

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DOCTOR

THIS MONTH THE DOCTOR TACKLES...

> Upgrade Timing
> Software Updates
> SSD Form Factors

The Eternal Question

I would like to build a gaming PC with a budget of $1,800. Will there be a major hardware upgrade this fall? Should I wait or just upgrade now?

—Fahd Boukhtioua

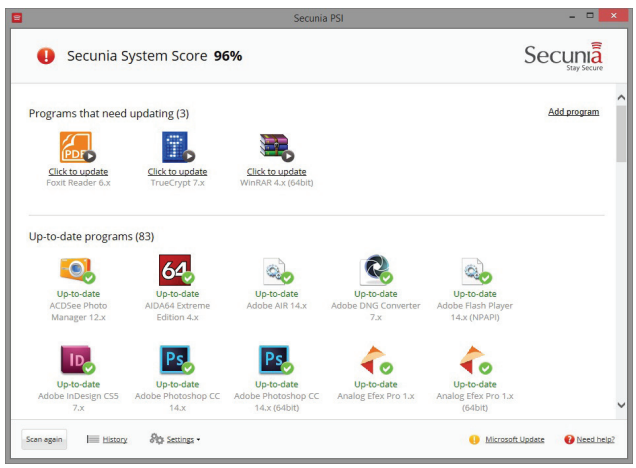
THE DOCTOR RESPONDS: With your budget, you should indeed wait and see how Intel's upcoming Haswell-E LGA2011-3 platform is received. Haswell-E will offer native 8-core chips as well as 6-core chips with additional PCIe lanes that aren't included on the normal LGA1150 platform. For a gaming PC though, the real question is whether you need to pay the premium and wait for a six-core CPU. Most games are perfectly fine with quad-core chips with Hyper-Threading, and less. There is, however, a fear that once developers begin to take advantage of the number of cores on game consoles, more cores will be better going forward for all PC games. It's just a theory at this point though, and most games run just fine on quad-core and even dual-core chips. One thing we do like about Haswell-E is its additional PCIe lanes, which can help with multi-GPU configurations. Since Haswell on LGA1150 and Haswell-E on LGA2011-3 are the same basic cores, you can't lose with either on the CPU front. It's everything around them that will matter. Haswell-E motherboards are likely to be premium-priced, and DDR4 memory—which will only be available on Haswell-E—will also be pricey. If the Doc had to pick between an LGA1150 box with a $700 video card or an LGA2011-3 with a $400 video card, the latter would be the choice for a gaming rig.

Windows Update Woes

My PC has been having freezing every now and again, and my friend who helped me build it using *Maximum PC* tips and tricks said that I have a lot of stuff that's not updated. I thought whenever Windows updates that it updates all programs on the computer, but I guess I was wrong. So my question is this: What program do you recommend I use to monitor every single program and driver on my computer to keep them updated?

THE DOCTOR RESPONDS: Keeping all your programs up to date is of critical importance. Malware authors target these programs (as well as Windows) to exploit vulnerabilities in them, so frequent updates are the only way to keep your system safe and running at top speed. As far as the Windows Update program goes, it's a selfish program in that it only updates itself, though it also updates and downloads other Microsoft programs such as Bing Desktop, so be careful before allowing it to update and install all by itself. We always recommend that you let it download updates, but then you go through and install them manually.

In terms of third-party software though, Windows Update totally ignores installed programs, so to keep them up to date you'll need to run a separate utility. There are a lot of paid apps out there that do this, but we've never used any of them. Our favorites are both free—SlimDrivers and Secunia Personal Software Inspector (PSI). SlimDrivers just shows you what drivers need to be updated, if any, and lets you update them right from the utility. You can also schedule it to check for updates on a daily or weekly basis. And if things go sideways after a driver install, it lets you uninstall drivers and restore older drivers from backup. Secunia PSI is a second option, and it's a hands-free updater in that it updates programs for you, unless for some reason the programs don't allow that to occur. In those cases, PSI notifies you from the system tray that you need to update them yourself.



Every power user needs to use a program like Secunia PSI to keep programs up to date.

↘ submit your questions to: doctor@maximumpc.com

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Both programs get the job done well and are free, so try them out and go with the one you like the best.

Refurbing an Aged Dell

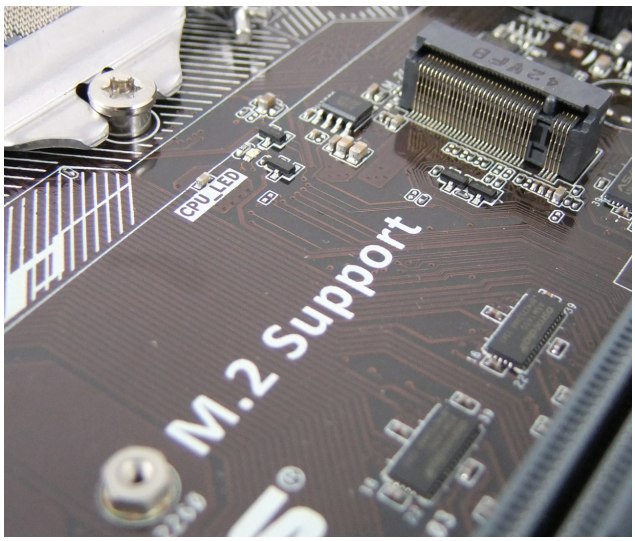
My Dell XPS 200, running Windows XP, had been the workhorse computer for the family for several years, and has served us well. In light of the end of support for XP and the desire to improve the performance of my PC, is it possible to upgrade/rebuild the computer using the XPS case? If so, would you be able to suggest some components and price range for such an upgrade/rebuild?

—Erik Gilliam

THE DOCTOR RESPONDS: Given that the XPS 200 is a small form factor case, and Dell that uses a number of semi-proprietary features on it to aid in the production-line building of it, the Doc thinks any upgrades would have to be pretty limited. To be honest, with the XPS 200 being based on the Pentium D, the Doc would recommend that you pull the hard drive and optical drive and recycle the rest in favor of building a more modern small form factor box. It's just not worth the heartache and headache to figure out how to maneuver hardware into that proprietary box. Sometimes, however, people want to do it just to do it. In that case, dropping in a modern SSD, more RAM, Windows 7, and a low-profile GeForce 750 card will make that machine faster, but ultimately, the Pentium D will be the bottleneck on system performance. The Doc likes to joke that Pentium D probably should have been named Pentium F because its performance isn't deserving of a D.

SSD Form Factor Confusion

I've just completed a new Haswell build with an MSI "Gaming Series" Z97 motherboard, which has an M.2 interface. I'm a little confused about what exactly I'll get over a regular 6Gb/s SSD using M.2. And I don't quite get which is better: M.2, SATA Express, or the PCIe SSDs that



Some Z97 chipset boards include a PCI Express–based M.2 port for SSDs.

I've seen popping up in a few articles lately. Since I have the M.2, I've been looking around and trying to find one (and can't), but now I'm thinking I probably don't need it anyway (and do they fail easily?). Can you give a layman's explanation on the benefits/differences of these three formats, and why I would need an even faster storage device? My Samsung 240GB 840 EVO is already plenty fast, for me at least. **—Ken Browning**

THE DOCTOR RESPONDS: Things are a bit confusing right now in the SSD world, Ken, because we're seeing the final days of SATA as an interface for storage while simultaneously witnessing the transition to PCI Express–based devices like M.2 and PCIe SSDs. These transitions take time, and if you recall when SATA first arrived, all hard drives had both SATA and PATA connectors on them for a year or two before the PATA connectors finally disappeared and everyone was onboard with SATA. The same situation will likely play out in the SSD world, where we'll see SATA stick around while we wait for everyone to get on the PCI Express train. In the meantime, a lot of motherboards are expected to use a PCI Express interface for SATA drives named SATA Express. Just like its name implies, SATA Express is a bridge between the old SATA interface and the next-gen PCI Express drives. It allows a SATA drive to connect to a motherboard's PCI Express lanes, and will also eventually allow PCIe drives to connect to it as well. Your M.2 drive is a full-blown PCI Express drive though, so unlike SATA, which is capped at roughly 550MB/s, PCI Express can scale much higher, and will allow us to quickly and easily double and triple the amount of bandwidth available for data transmission. For what it's worth, M.2 currently supports faster speeds than SATA 6Gb/s, but only up to around 800MB/s at this time, so we doubt it will "feel" any faster than your 840 EVO. One other thing to note is that SATA drives use the AHCI protocol to talk to the OS, but that's a protocol designed in the hard-drive days. When PCI Express comes online for real, we'll see a new protocol named NVME, which stands for Non-Volatile Memory Express. This protocol is designed specifically for solid-state drives, and will allow for major increases in performance in the future, as it gives the drives more headroom to run as fast as they can instead of being hobbled by a hard-drive protocol.

Long Load Times

Doc, I currently have an ASUS PC with a 3.4GHz Core i7-3770 CPU, 16GB RAM, Windows 7, and a GeForce GT 620 2GB video card. When I open an existing slideshow project in Adobe Premiere Elements, it takes an extremely long time for all the pictures to load. The project opens and then I sit and wait for each photo to load. Am I waiting for the processor to read each image file, or am I waiting on the video card? Would upgrading to a Gigabyte GTX 750 speed this up? **—Arthur Lang**

THE DOCTOR RESPONDS: Arthur, your system is actually fairly well spec'd for running Premiere Elements. The Ivy Bridge–based Core i7-3770 is a quad-core part with Hyper-Threading, you have 16GB of RAM, and you have discrete graphics. One you thing did not mention, and the Doc believes to be the main culprit, is your storage setup. First, don't bother upgrading to the GeForce GTX 750. Unlike Premiere Pro, Premiere Elements doesn't use the GPU to enhance previews or encoding. There is some GPU support but not enough to switch from that GeForce GT 620 card. The Doctor really suspects the issue lies with a slow HDD or an HDD that just seriously needs to be defragged and cleaned up (HDDs get drastically slower as they get full). The other possibility is that malware is to blame for dragging down your box, but to be honest, it's usually a cop-out to blame "malware." Still, it's never a bad idea to root out malware, so run a full scan and get second opinions from Malware Bytes and AdwCleaner, too. One final thought—you didn't say which version of Elements you're running. Premiere Elements 12 has 32-bit and 64-bit flavors, and chooses which version to run based on what OS it's running on. The Doc believes that only Premiere Elements 10 and Premiere Elements 12 actually have 64-bit support. If you're running an older version, you are likely running 32-bit mode, which isn't the best environment for video editors, even if your machine has 16GB of RAM.

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by Gordon Mah Ung
and Tom McNamara

BUILD IT!

Grab your screwdriver, it's time to build a new PC

Build it. DIY. Roll your own. Whatever you call it, there's nothing more satisfying than putting together your own computer.

Sure, you can argue that there's no point to it anymore—OEMs get such a big price break that at best, your DIY rig will cost $100 *more* than a buying a pre-built PC—so why even bother? The most obvious reason to build your own rig is that *you* get to pick every single part. Want a teal-and-pink case for your *Miami Vice* homage PC? You can do it. Want to stuff a $1,500 GPU into a machine with a $75 CPU? You can do that, too.

The most compelling part of rolling your own PC, though, is the pride you get from using your hands to turn a pile of parts into a working, breathing computer. You built it, not some faceless assembly-line worker.

The good news is that building a new PC has never been easier. If you can turn a screwdriver with any confidence, you can put together a new rig yourself, once you've read our step-by-step story. Even better, we'll also teach you how to pick parts like an expert, so you can confidently build the computer that fits your needs exactly, not the needs some big-box store has determined for you.

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The Five-Minute Abs of PC Part-Picking

Don't get overwhelmed, we'll teach you how to be a PC part-picking expert in no time

The hardest part of any new PC build is picking your parts. How much RAM do you really need? How do you really pick a GPU and CPU, and do you really want a mobo with dual Thunderbolt 2 ports? While this is information we could easily write ten magazines about, we're going to try to distill this down to small nuggets any new PC builder can absorb to help ease being overwhelmed by the process. This information is not the last word nor everything you need to know, but it should be enough to get you going so you don't end up under- or over-buying parts for your new computer.

Not everyone needs the power of a six-core CPU, so why pay for it?

HOW TO PICK A CPU

AMD or Intel? This is a tough question, but let's generalize this way: Intel's CPUs are better than AMD's CPUs right now in actual CPU chores. If you want the best performance per chip, Intel is the answer. The only time this flips on its back is if you're going to run integrated graphics with entry-level gaming as your primary goal. If so, choose an AMD APU. But even AMD fan boys agree Intel's CPUs are in front today—so, OK, so it's Intel. Now, you need to decide how many cores: 2, 4, or 6? For most people, a quad-core chip is the right choice for general computing, gaming, and photo or video editing on the task list. Six cores is too much for 90 percent of people's needs; two cores will work, but if you're a heavy multi-tasker or do even a modicum of content creation, you will feel the dual-core's weaknesses. We're not saying it can't be done, but our recommendation for all but the budget buyer is a quad-core CPU. Since you're buying Intel, you still have a choice between older Ivy Bridge CPUs and the newer current Haswell parts. Today, frankly, there's no need to buy Ivy Bridge parts. Haswell offers better performance and more modern amenities.

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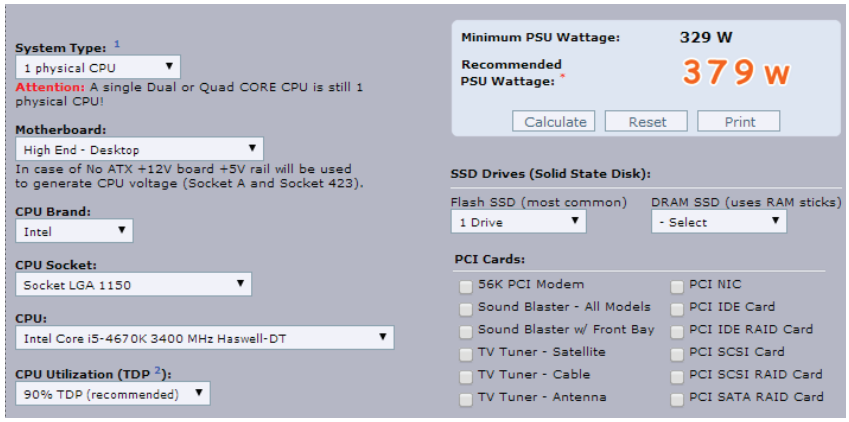
Outervision's PSU calculator gives you a good ballpark estimate for sizing your unit, but we like to add 20 percent to be conservative.



HOW TO PICK A MOBO

With most of the performance of a motherboard relying far more on the CPU, mobo buying today is more about getting the features you need and no more. If you need Thunderbolt 2, it'll cost you, but if you don't need Intel/Apple's highfalutin interface, don't pay for it. Build a list of your needs: How many USB 3.0 ports, how many SATA or PCIe, and whether you want M.2 or SATA Express. Also think about the future: Do you really intend to run multiple GPUs? If so, make sure your board has support for it, as not all do. Some, for example, have CrossFire but not SLI.

The bundled utilities with the motherboards are also an important differentiator. Some are bare-bones, while others, such as Asus, offer exceptional software. Another important differentiator today is onboard audio. Our general recommendation is to lean toward a board with engineering put into the audio subsystem. For example, Brand A's may not be better than Brand B's, but in general, it'll be better than a lower-end board with no separated audio path. Finally, we recommend buying 9-series chipsets for Intel and A88X for AMD's APU for the forward compatibility they offer. As far as size or form factor, ATX is the standard and is our preference for most builds.

HOW TO PICK A GPU

It's actually not as hard to pick a GPU as you may think it is. Basically, the more expensive it is, the more powerful it is. Yes, a $300 GPU is faster than a $250 GPU. It's just a question of how much you want to spend. Before you pick, though, consider what resolution you want to game at. If it's a single monitor at 1920x1080, generally—and this is a very general guideline—a $250 GPU will give you a solid 50-plus fps performance in 95 percent of today's games, with occasional dips. As you scale up in resolution, or if you simply want a solid higher frame rate all the time, pay more. If you intend to run at 2560x1440 on a 27-inch panel, you're solidly in the $550-or-more range in GPU expenses. For most people though, $250 is the sweet spot in GPUs, and will give you a solid experience at 1080p in most games with few compromises in visual quality.

HOW TO PICK A COOLER

For the person who will never overclock, the stock cooler is actually a good option. It's free and AMD or Intel have done the actual engineering to ensure that it works under 95 percent of situations. If you intend to overclock though, an aftermarket cooler is mandatory. Our rule of thumb is don't spend more than $35 to $45 for an aftermarket air cooler. Once you've passed that mark, our advice is to buy a closed-loop liquid cooler. There's no maintenance, and they're generally quieter and outperform most air coolers. CLC's come in all shapes, sizes, and prices, so buy on your needs. If you intend a mild to medium overclock, a single 120mm CLC is enough. If you intend to push the overclock harder, a dual 240mm CLC gets you better cooling performance or less noise than a 120mm-size CLC.

HOW TO PICK RAM

For the most part, RAM is a commodity like pork bellies. The chips are made by a handful of players and then sorted by the memory makers you mostly recognize. Unless you get no-name generic RAM, memory from any of the respected RAM makers will get the job done. That's not all, though. You need to think about how much and how fast. For capacity, 8GB is our recommendation for a normal build. We'd keep 4GB in the budget category. Going to 32GB or for many, 16GB, won't net much difference. Your second decision is clock speed. Today, we think the sweet spot is DDR3/1866. Anything more is luxury but does actually net some performance gains on Haswell CPUs. If you intend to run integrated graphics though, get the highest clock speed you can afford (and that your mobo will run), as it directly impacts gaming performance.

HOW TO PICK AN SSD

You can spend two days trying to decide between this type of X NAND or that type of Y NAND, but the truth is that with the performance of SSDs gated by the SATA interface, your primary influencers should really be capacity, price, software, and warranty. These matter much more than whether one SSD is five percent faster in one type of disk-intensive task than another. That doesn't mean a low-end or old SSD is the answer. Newer SSDs almost always use more current technology and are preferred over older drives. For capacity, 128GB is the entry level on SSDs and 240GB or 480GB and up is preferred to make your life better. Basically, a mid-range or higher SSD from a trusted brand is enough to avoid heartache today. Finally, remember to have a backup going. SSDs die just as HDDs die, so plan on dealing with it.

HOW TO PICK AN HDD

The HDD is important but we've come to the conclusion that it should only be used as a primary storage device on the most budget of builds. So, forget about the RPM or access times—that's 2009 thinking. The only real factors in an HDD are capacity, price, and warranty. For most people, a 1TB drive is the minimum for a new system, with the true sweet spot today being 3TB. As far as the all-important "reliability" factor, we recommend that you don't bank on that. Yes, a longer warranty usually tells you how long the company thinks it might last, but it won't tell you how long *your* particular HDD will last. We recommend backing up your SSD to your HDD and then backing up your HDD to a NAS or a secondary HDD.

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HOW TO PICK A CASE

Picking a case is the most personal decision you make. There's really no easy way to answer this question for you, but just know that most people will want a standard ATX case. Niceties to look for include generous cutouts to access the back of the motherboard, wiring ports, and removable drives cages. If you want more info, check out this month's budget case roundup on page 54.

HOW TO PICK AN ODD

This is a category you don't have to burn too much brain power on. A $20 Asus/Samsung/LG/etc. SATA DVD Burner will get the job done. If you are contemplating using a slim USB-based drive, just know that if you intend to use it for a lot of burning and ripping, laptop drives in the slim cases usually stink in performance, and it's not USB's fault. Laptop drives tend to be significantly slower than desktop SATA drives.

New builders often overspend on unnecessary motherboard features. If you don't need Thunderbolt 2 or Wi-Fi, go for a different board.

HOW TO PICK A PSU

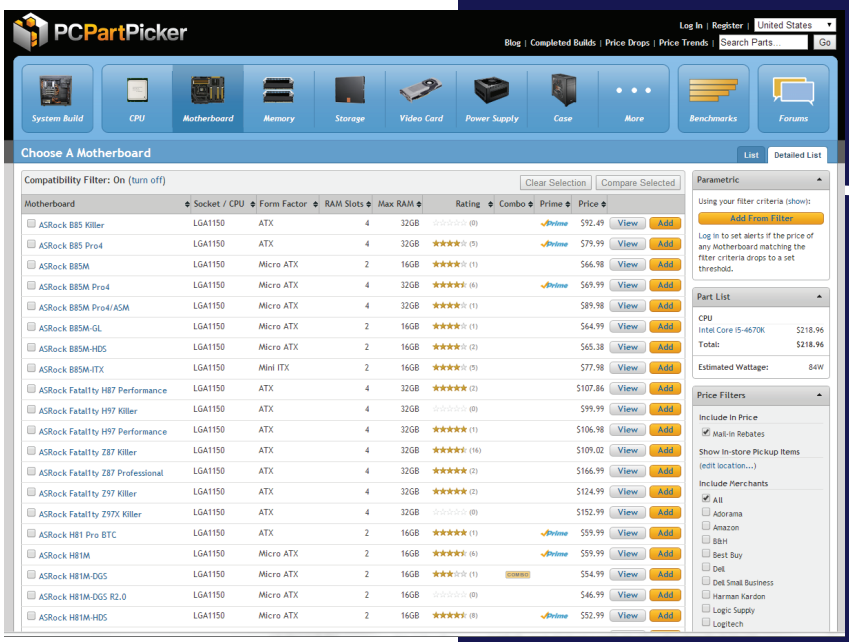
Your first criteria in picking a PSU is the obvious: Will it power my hardware? There are about a dozen different PSU calculators you can use on line. The most popular is Outervision's at http://extreme.outervision.com/PSUEngine. According to the calculator, for a standard single processor, single high-end GPU system with SSD, HDD, and 16GB of RAM—believe it or not—a 500-watt PSU is acceptable today. We'd agree with that assessment, but we'd add a little more wattage for summer months and potential future hardware. You may be confused over the multi-rail vs. single-rail, but for normal PCs, don't sweat it. Only when you get to extreme builds do you need to pay attention to per-rail amperage needs. You will definitely want to make sure the PSU has the ability to run the number of GPUs you will use. Finally, consider the warranty as a good measure of the quality of a PSU. A PSU with a one-year warranty is very likely to be inferior to one with a five-year or seven-year warranty. The rest is really just gravy: digital control, monitoring, and modular cables.

Web Help

YOU'VE GOT A ROUGH idea of what you might want in your PC, but now you're overwhelmed by the sheer amount of parts out there.

One of the best tools available today is PCpartpicker.com. It's a one-stop shop for helping you price out and configure your system. Just click the system build button and start selecting your parts. Selected parts will filter out other parts you don't need—pick an LGA1150 CPU and it will only let you pick from LGA1150 motherboards. The tool crawls popular stores for the latest in prices and rebates, too, so you don' t have to.

PCpartpicker.com only helps you sort through the bazillion parts out there. If you want to research the key components you're confused by—say, the CPU and GPU—you can look at Cpuboss.com, Gpuboss.com, and Passmark.com for general comparisons of CPUs and GPUs. These sites offer very high-level views of the products, but they will at least get you in the ballpark of what you want. From there, we recommend drilling down into other such valuable sites (ahem, Maximumpc.com) to get a better feel for the particular parts. One more site we'd recommend to aid in decoding the CPUs is Intel's ark.intel.com. It helps sort out the exact differences between the billion different CPUs Intel offers today.



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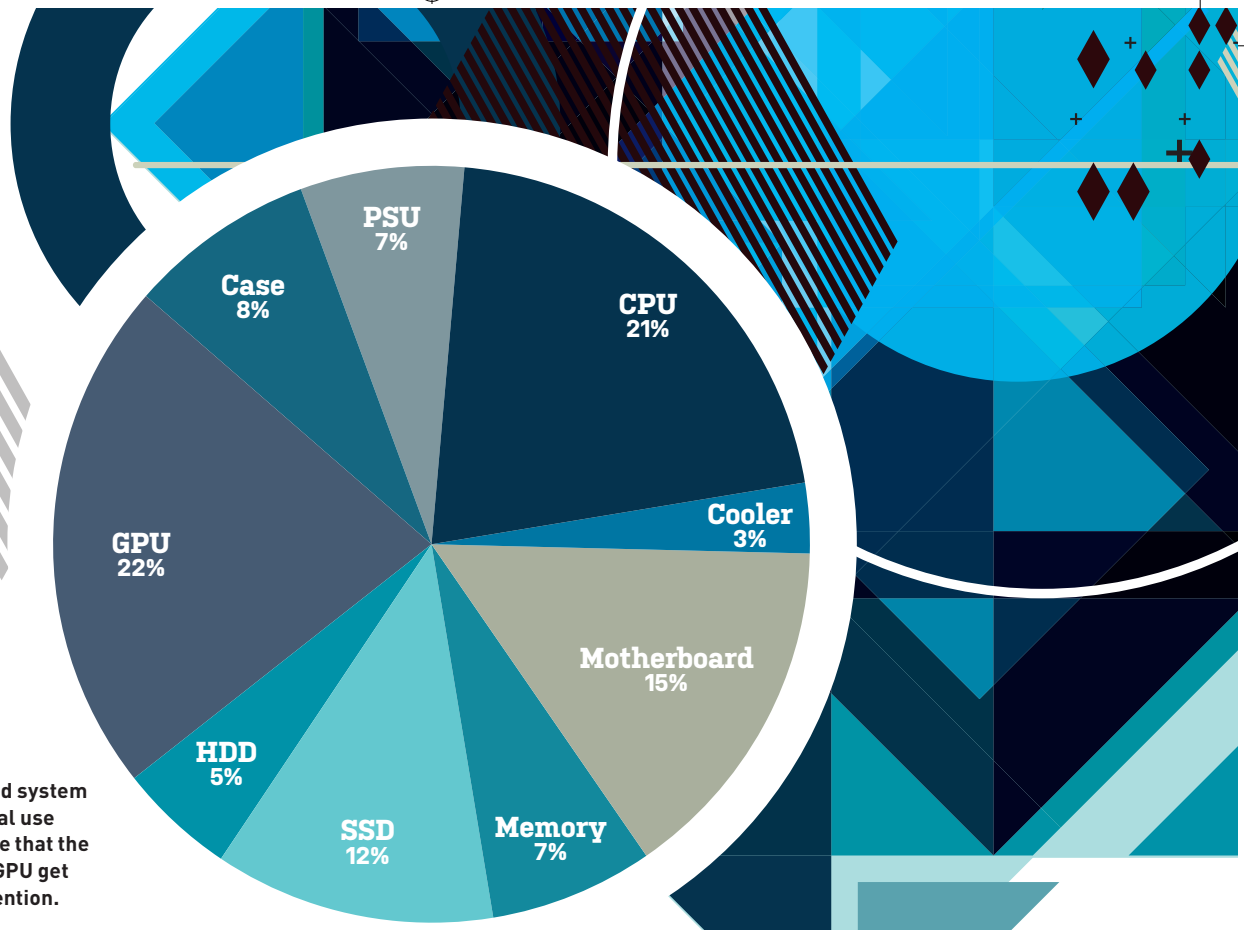

A balanced system for general use should see that the CPU and GPU get equal attention.

WHAT WE BUILT AND WHY

BEFORE WE WALK YOU through how to build your first PC, we'll show you the parts we picked and tell you why. The two most important were the CPU and GPU. For the CPU, there are cheaper CPUs to be had, but Intel's Core i5-4670K delivers the most bang for the buck. It easily overclocks beyond its base clock of 3.4GHz and its four cores easily outrun dual-core parts. It is, essentially, *the* part to have for a budget enthusiast who does some content creation and gaming. Our box is a "balanced" build, so we spent a reasonable amount of cash our video card. At $249, the Asus GeForce GTX 760 gives us solid 1080p gaming with the latest games. Mind you, it's not a solid 60fps on max settings, but with a few tweaks that most would never notice during game play, you could get there. The other important part here is the SSD. We thought about foregoing an SSD and making a few other trims to get the price under $800 but decided that any new machine you build should make you smile—and nothing makes you smile more these days than an SSD. We could have dropped the capacity to 128GB as well, but it's just too hard to live with a boot drive that small, and doubling the capacity only costs about 30 percent more. You should know the Core i5-4670K comes with a stock Intel heatsink. If you never intended to overclock, this would be fine, but since we intend to take advantage of the free performance from the Core i5-4670K, we plunked down the cash for the Silverston AR01 cooler.

The last part to highlight is the MSI Z97-Gaming 7 mobo. This is a solid board with an M.2 slot for faster SSD performance-upgrade potential, as well as support for SLI and CrossFire, and a separated audio path on the PCB for theoretically cleaner sound. We don't need the direct voltage readouts, but at $164 you're getting a lot of motherboard value with the Z97 Gaming 7.

One last thing we like to do is look at how much each component costs as a percentage of the entire rig. This gives you an idea if your system is "balanced" or not. By balanced we mean if the system is properly weighted toward its use. In this case, it's a balanced machine with slightly more going to the GPU than the CPU. If we were building a pure gaming rig, we'd tilt the configuration to put more into the GPU. If the box were to be used for content creation using videos and high-resolution still images, a shift to more money on the CPU would be advised. If you simply want to store an insane amount of files on the drives, spend more of your budget on HDDs.

CPU	Intel Core i5-4670K	$229
Cooler	Silverstone AR01	$34
Motherboard	MSI Z97-Gaming 7	$164
Memory	Kingston Black 8GB DDR3/1600	$79
SSD	Sandisk Extreme II 240GB	$129
HDD	Western Digital Caviar 1TB Blue	$58
GPU	Asus GeForce GTX 760 DirectCU II	$249
Case	NZXT Source 530	$88
PSU	SeaSonic G 550	$79
	Total	**$1,109**

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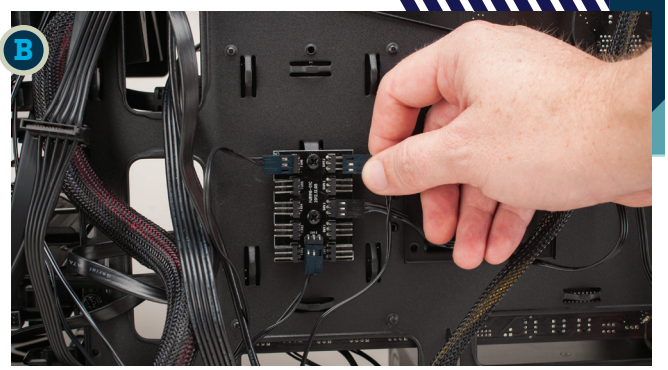
STEP 1
THE CASE

The NZXT Source 530 is a full-tower case with two 120mm fans in it. That's a pretty standard fan size, though 140mm is increasingly common. These fans attach to the case with specifically designed screws **(Image A)**. They have a fatter bore and a coarser thread than normal. Our case came with a small box full of little baggies containing a variety of screw types for different applications. Thumbscrews are a popular type, and our case uses two in the back to keep the side panel on.

When attaching a fan, don't put the first screw all the way in. Just most of the way. Then go diagonally across to the second hole, putting that screw in most of the way, too. Then, attach the other two screws (again, most of the way) in any order you like. Once all four screws are attached, you can finish tightening them. Waiting until this point to tighten gives you more room to wiggle the fan around if it's not lining up perfectly with the holes. When you put the motherboard in later, you'll plug the fan cable into a case fan connector on the board. Our case has a fan hub, however **(Image B)**, so we plug our fan into that instead, then plug the hub directly into the power supply unit (we'll talk about the PSU in a bit).

A

B



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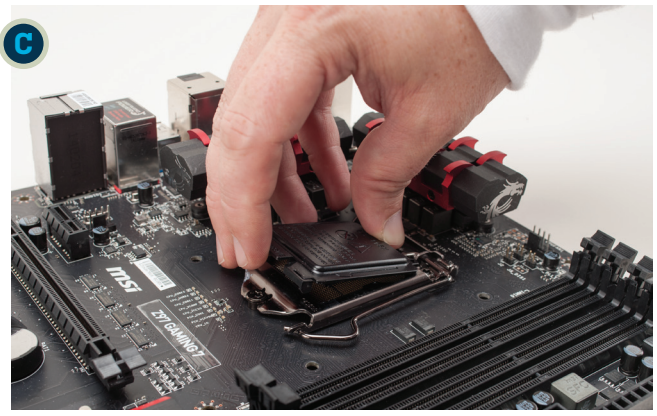

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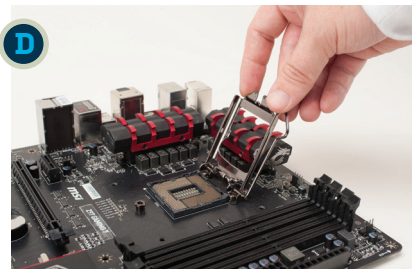

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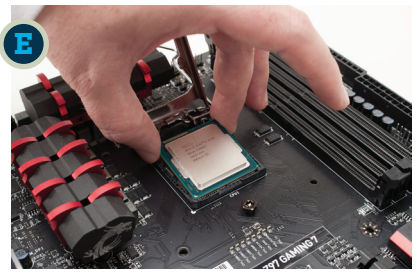

STEP 2
THE CPU

Retail motherboards get shipped inside an anti-static bag. Place the motherboard on top of this for now. The CPU tray is protected by a plastic cover. You can pop that off by pulling a tab on one of its sides **(Image C)**. Do not throw this cover away. If you need to return the board for service, the maker may not accept any motherboard without this cover in place. Next, there's a metal lever that secures the actual CPU bracket. Pull the end of this lever out, then pull up to free the bracket. It should swing clear of the tray (**Image D)**. Now, look for a small gold triangle on one of the corners of your CPU. There should be a corresponding marker on the motherboard. You want to line up these two markers to make sure the CPU is oriented correctly during installation **(Image E)**. Once you've set the CPU in the tray according to the markers, put the bracket back on top, and return the lever to its original position.

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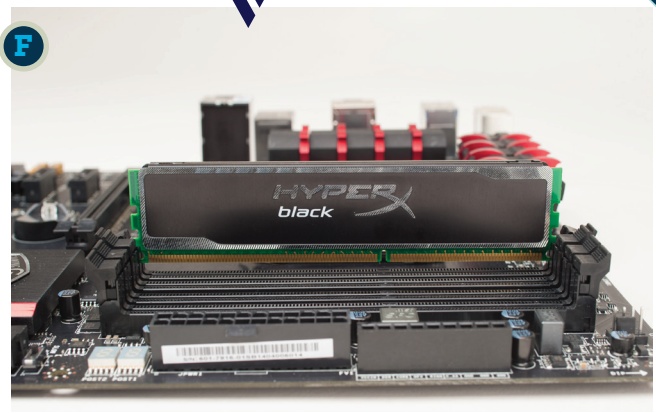
STEP 3
THE RAM

Our motherboard has four slots. We'll be using slots 1 and 3 (counting from left to right). Your board manual will tell you which slots to use for different RAM configurations (please follow it). Each RAM slot has tabs on either end **(Image F)**. At least one of these can move out of the way to allow RAM installation. Each slot also has a notch that corresponds to a notch on the stick. Line up these notches **(Image G)**, and press the stick gently but firmly into the slot until you hear the tab click. You may need to use a see-saw motion to get the stick in.

F



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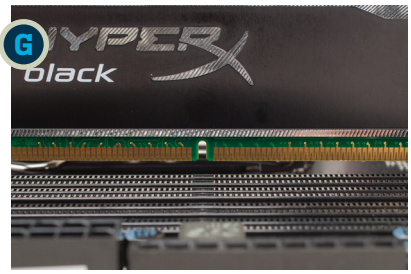
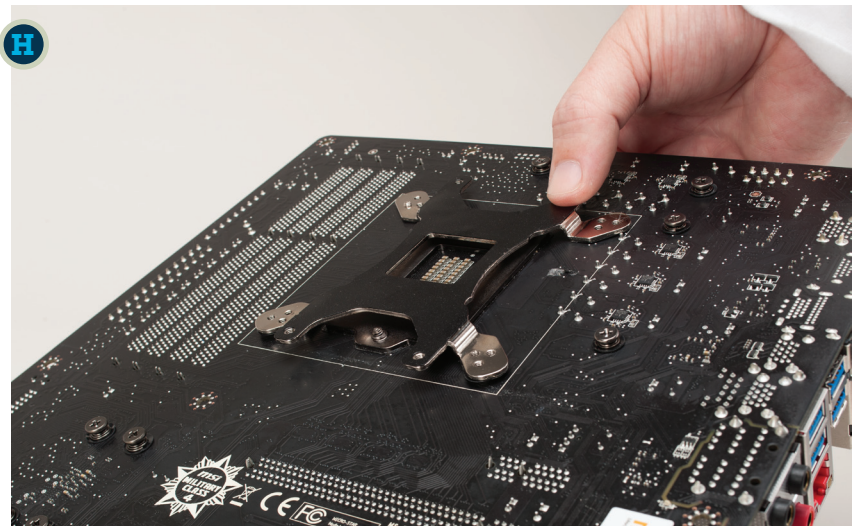


STEP 4
THE CPU COOLER
(PHASE ONE)

You could use the stock cooler that comes with a retail Intel CPU, but we chose an "aftermarket" variant, the Silverstone AR01, since we want the option to push the CPU beyond its factory settings. This cooler is comparable to a Cooler Master Hyper 212 Evo. We use the Evo a lot, so we wanted to switch things up a bit.

The backplate installs first. This one has three sets of screw holes. Stand the motherboard on an edge, and rotate the backplate slightly until you can see through four screw holes to the other side of the motherboard **(Image H)**.This backplate will not end up perfectly square, and it may take a minute to line up. The cooler comes with a set of screws that attach on the other side of the board. Each screw also gets a spacer to help prevent damage **(Image I)**. Like with the case fan, don't put the first screw all the way in. Go most of the way, then go diagonally across and do that screw next. Then go most of the way with the third and fourth, then fully tighten all four screws.

H



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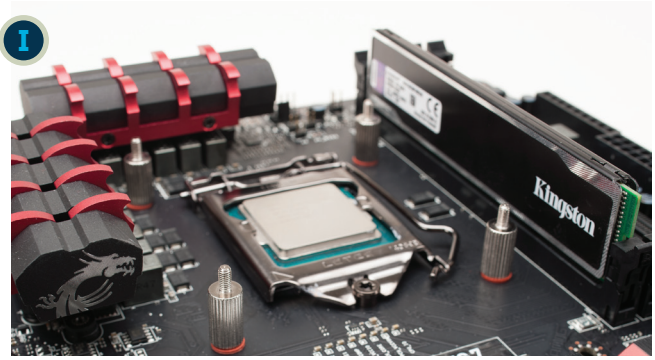

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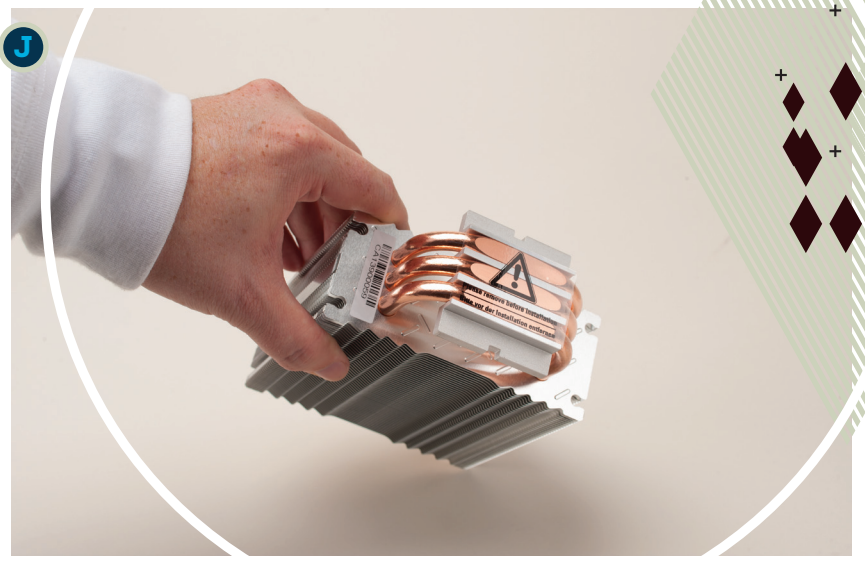
STEP 5
THE CPU COOLER
(PHASE TWO)

You can set the motherboard back down now. The AR01 comes with two sets of brackets—one for AMD CPUs and the other for Intel CPUs—and the manual will show you which to use. Pay close attention to how the brackets' screw holes are oriented. Basically, you want to be able to draw an invisible "X" over the CPU, using the diagonal line of the bracket's screw holes as a guide. Now, attach four nuts to the brackets to set them firmly in place. At this point, you're ready to put thermal paste on top of your CPU. Apply a small pea's worth, peel the protective plastic off the bottom of the CPU cooler **(Image J)**, and set the cooler on top of the CPU.

The AR01 has another bracket that goes underneath the cooler's radiator fins, connecting the first two brackets to each other **(Image K)**. This third bracket has two bundled screws. As with the case fan and the backplate screws, don't put the first screw in all the way. Just part way, then attach the other and put it in part way. Alternate between the two until they are tight. Lastly, connect the cooler's fan to the appropriate connector on the motherboard **(Image L)**.

J



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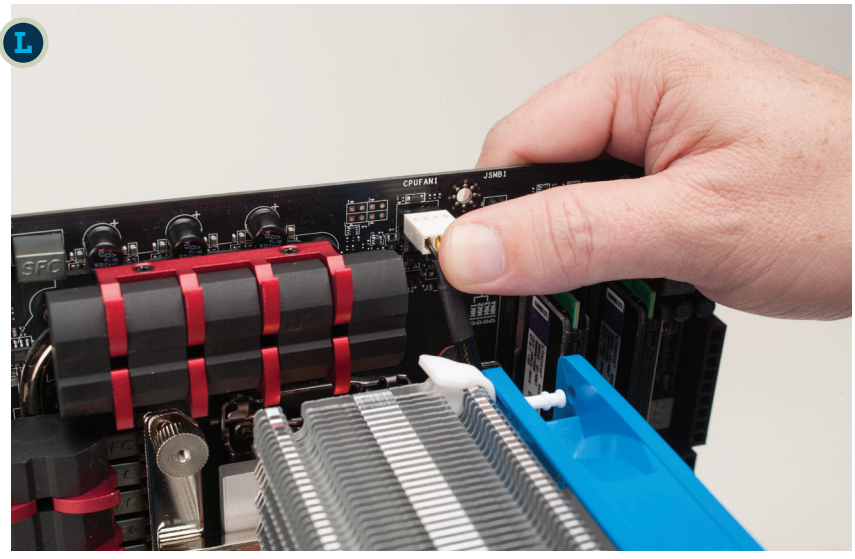

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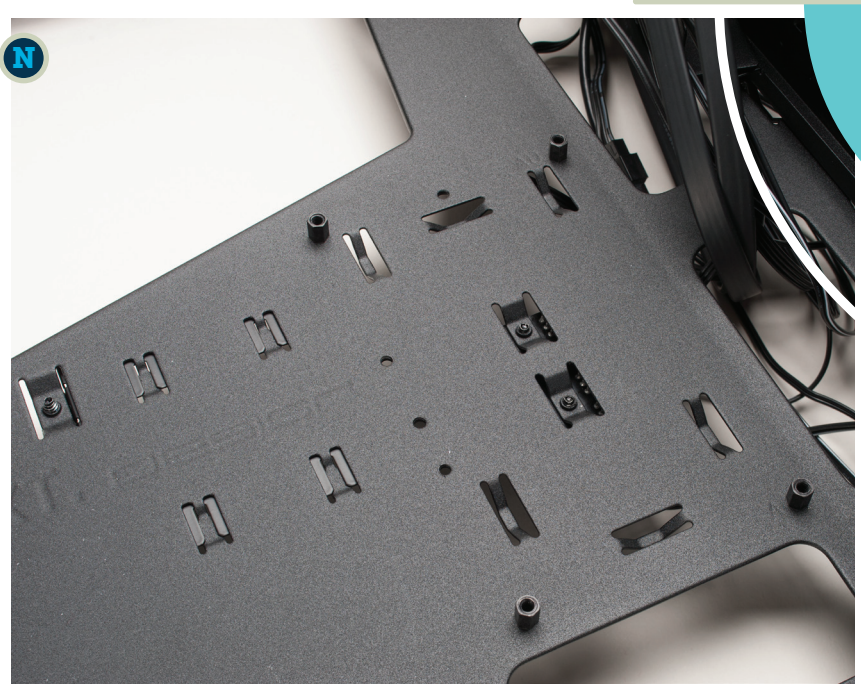
STEP 6
THE MOTHER-BOARD

This motherboard comes with an individually packaged I/O shield. The shield does not use any screws. Instead, you just press it into the rectangular hole in the back of the case, and it uses tension to stay put **(Image M)**. You may need to tap a corner or two with the handle of a screwdriver to get the shield to pop in all the way. Now, you can set the motherboard down inside the case. Since the Source 530 has built-in standoffs **(Image N)**, we don't need to install those separately. However, you still need to apply some pressure against the I/O shield to get the screw holes on the motherboard to line up with the screw holes in the standoffs. But after one of those screws is in, you can take the pressure off. There are usually nine holes in all. Your case should come with screws sized for motherboards.



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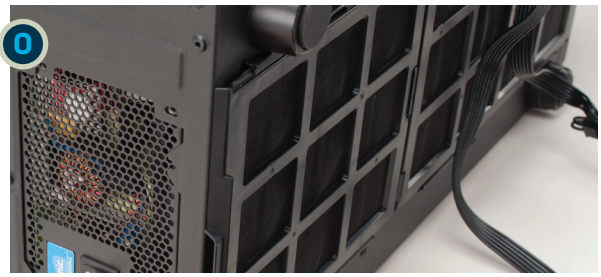
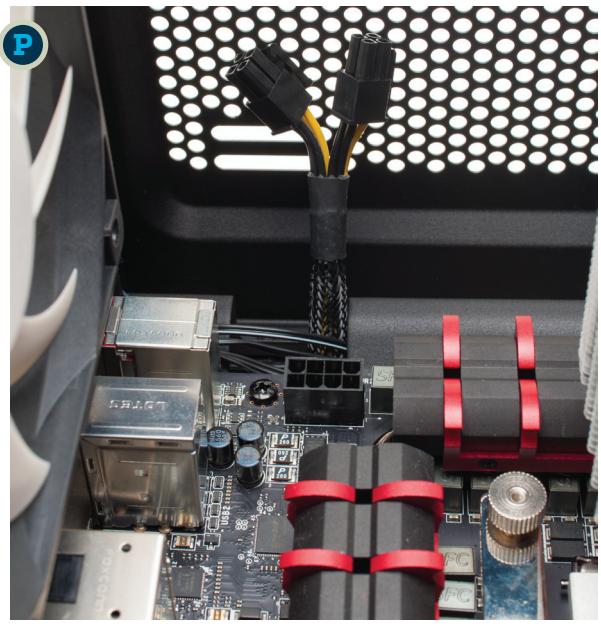
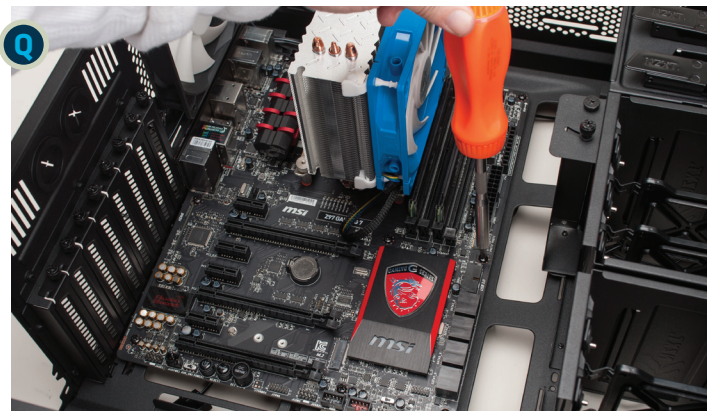
STEP 7
THE POWER SUPPLY UNIT

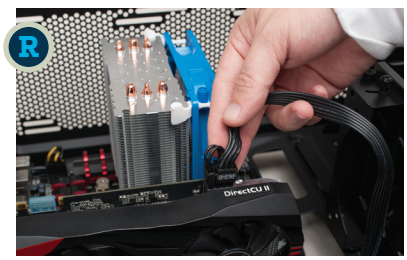
In this case, the PSU sits in the bottom. Below is a grill for air intake, so you place the side of the PSU that has the fan on it against this grill. Underneath this case is also a filter to keep dust from getting in **(Image O)**. The case comes with four screws that attach the PSU to the back; for easy identification, these screws have hexagonal (six-sided) heads on them.

Our PSU is semi-modular, so its CPU and motherboard power cables are permanently attached, but the other cables are not. From the bag that comes in the retail box, we'll pull one cable labeled "PCIE" for the video card, and two cables labeled "SATA" for our three storage devices (each SATA power cable has multiple connectors). One end can only plug into the power supply, while the other end is "keyed" to fit into the device. We can feed cables behind the motherboard tray to keep our case presentable. There is a cutout at the top left-hand corner of the motherboard tray to do this with the CPU power cable **(Image P)**. You'll need to remove the case's other side panel to get behind the mobo. Customarily, it's secured by two large screws at the back of the case.









STEP 8
THE VIDEO CARD

Counting from the top of the case, we'll be removing slot covers 2 and 3 from the rear **(Image Q)**. You may need to temporarily remove slot cover 4 to get enough clearance for the video card's bracket. Once the card is in the slot, secure its slot bracket with one of the thumbscrews that you just removed. The bracket has both notches and holes. Use a hole for the best results.

Take that PCIE power cable we connected to the power supply earlier and plug the other end into the card (after feeding it behind the motherboard, if you like). This card uses an eight-pin cable, and our cable is "6+2," meaning that it has two pins that can detach if you only need six pins in total **(Image R)**. Like the CPU and motherboard power cables, this one will snap into place when it's secure. If the connector isn't going in, try rotating it 180 degrees first, rather than trying to force it.

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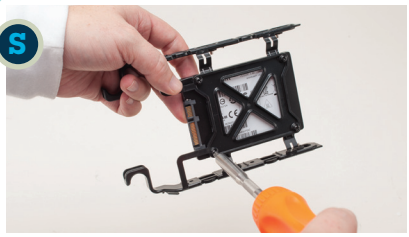
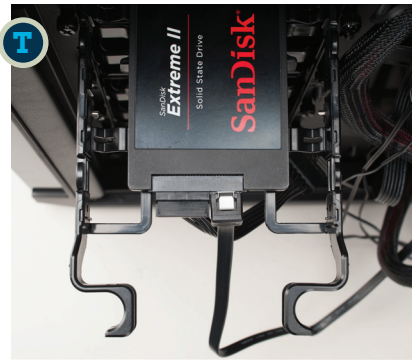


STEP 9 STORAGE

This case has removable trays that come out from the "far" side. They move when you pinch the tabs sticking out. For a 2.5-inch drive like an SSD, you screw it directly into the tray **(Image S)**. Make sure that the drive's connectors are pointing toward the tabs, to make it easier to attach cables. Your SSD may come with small screws for this purpose. We had some screws bundled with the case that had "brims" on their heads, of two different lengths. We used the longer screws. For 3.5-inch mechanical drives, the tray has preinstalled nubs that snap into where screws would go.

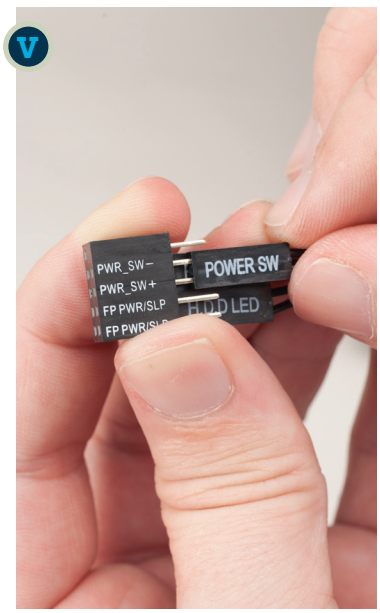
Next, you can feed your SATA power cable from the power supply. You may need to move your drives to different trays to best accommodate the distance between each connector on the cable. Your power supply may also come with multiple SATA power cables that you can experiment with. The connectors on the cable and the drive are slightly "L" shaped, so they can only go in one way. Once those are connected, grab the SATA data cables from your motherboard's retail box. You'll usually see a combination of "straight" and "right-angle" cables. Right angles are for tight spots **(Image T)**. On our motherboard with Intel's Z97 chipset, all of its SATA data cable ports (toward the lower left-hand corner) will behave the same, so you can plug into whichever is most convenient. We recommend that you consult your mobo manual for where to install them, but we always prefer the ports from the Intel or AMD chipset.



STEP 10 OPTICAL DRIVE, AND SOME WIRING

The large drive bays on the front of our case have tabs to help remove their covers. We chose the top-most one, making it easier to reach if the case is on the floor. The side of this drive bay has a latch you pull out before sliding the drive in **(Image U)**. Once the front bezel of the drive is flush with the front of the case, you can put the latch back down. No screws are required here. Next, we connect the SATA power and data cables like we did with the SSD and mechanical hard drive.

Last but not least, this motherboard comes with a block of pins that plug into a connector on the lower right-hand corner of the motherboard **(Image V)**. This block connects to a set of wires coming from the front of the case that handle the power button, reset button, and activity lights. The negative wire is usually white. This area of the board usually also has a connector for the front panel's USB 2.0 ports. Our case has only USB 3.0 ports, so we plug that into a USB 3.0 header near the RAM slots. On the lower left-hand corner of the board, you will customarily find the header for the cable that connects your front headphone and microphone jacks to the board. Like the internal USB 2.0 ports, its pin arrangement is designed so that the connector can only go in one way, so check that before plugging in the cable.



INSTALL WINDOWS 8.1

Your box is built, time to use it!

INSTALLING WINDOWS 8.1 is a snap, but for the uninitiated, it can be a scary task. We'll walk you through the basics of getting an OS onto your drive. And yes, if you bought Windows 7, it's pretty much the same steps.

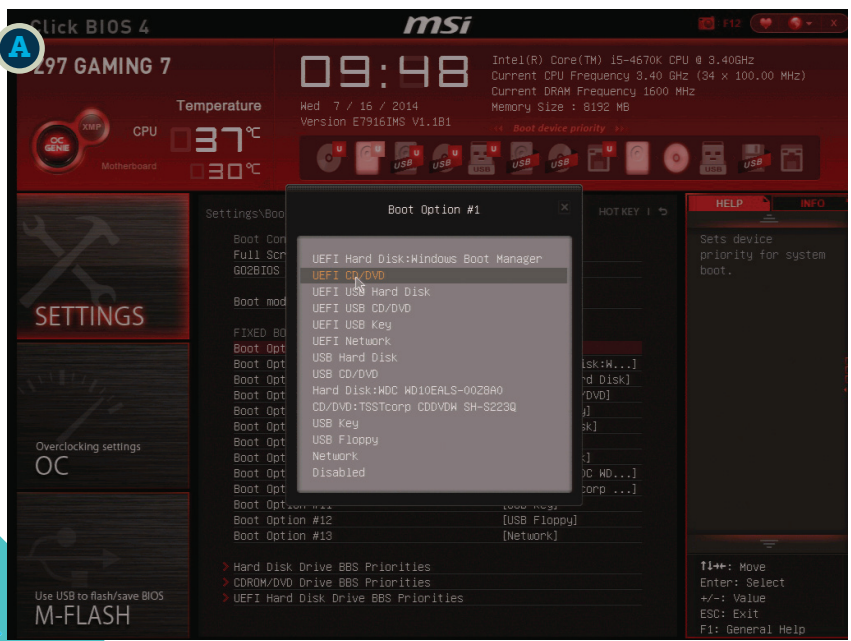
If you bought Windows 8.1 from a retailer, you're likely installing it from a DVD. To get started, just put the disc into the drive and boot your box. If the SSD and hard drive are the first boot devices and completely blank, the system should boot straight to the installer. If you're recycling an SSD or HDD, the system may try to boot to the old OS. In that case, you'll need to change the boot order in the UEFI/BIOS (the sort-of operating system equivalent for the hardware itself, which loads before Windows does) to make the CD/DVD the first boot device **(Image A)**.

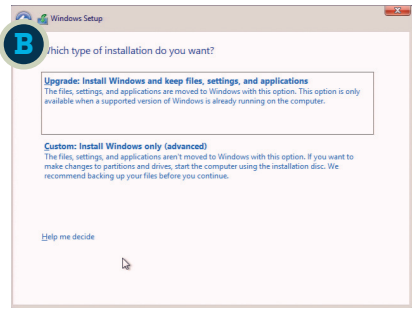
As Windows starts the install, it'll first ask you for your Product Key. That's the serial number for this copy of Windows. Mind you, this is for the retail version of Windows. An Enterprise version that you install for a 90-day trial won't ask for a product key. Input it and press enter. You'll soon be greeted by a licensing terms screen that you'll have to agree to. Then, Windows will ask you what type of install you want, an upgrade or custom **(Image B)**.

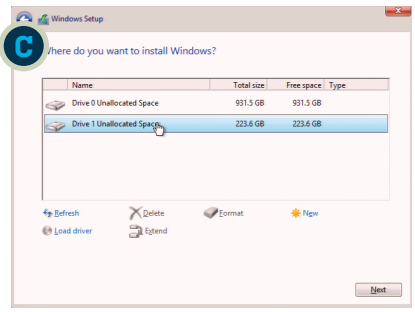
Select Custom, which will bring you to a screen that should show you both drives you can install the OS to. Select your SSD as the target. You can tell it's the SSD by its smaller capacity **(Image C)**.

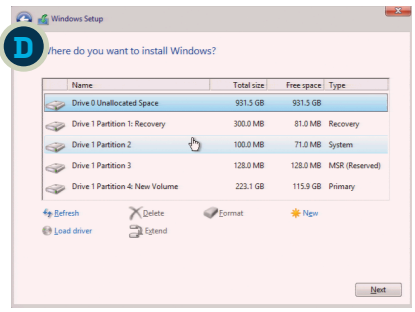
If you did reuse an older SSD or HDD and don't want the data, you'll see all of the partitions to select from in Windows. Since you don't want that old data (right?) we recommend that you delete all of the previous partitions on the target drive by selecting each partition and pressing the Delete button **(Image D)**. We don't recommend that you ever have any "hot" drives with data you want to keep plugged in during and OS install, to reduce the chances of you wiping your data by accident.

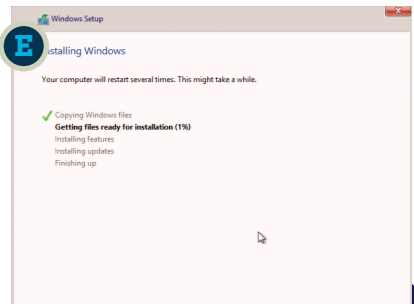
That's it. Windows will start the install and take anywhere from 10 to 20 minutes to complete **(Image E)**.











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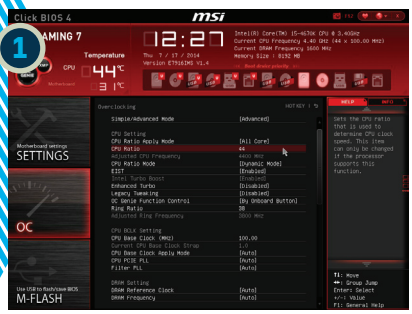
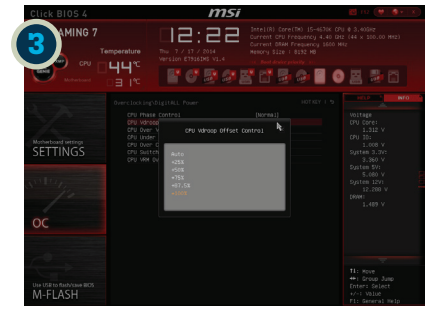




OVERCLOCKING 101

Because factory settings are for wussies

OUT OF THE BOX, our quad-core Intel Core i5-4670K CPU will run at 3.4GHz. But when a task doesn't need all four cores at once, the chip will engage a "turbo" mode and push to 3.8GHz on one or two cores. These speeds are based on clock multipliers. The CPU has an element called a base clock that runs at 100MHz, and its non-turbo setting multiplies that 34 times to get 3,400MHz, aka 3.4GHz. Our CPU's name has a "K" at the end, so the clock multiplier is unlocked. We can dive into the BIOS and crank up this multiplier. Motherboards usually also come with performance-tweaking software, but we prefer the fine-tuning available in the BIOS.

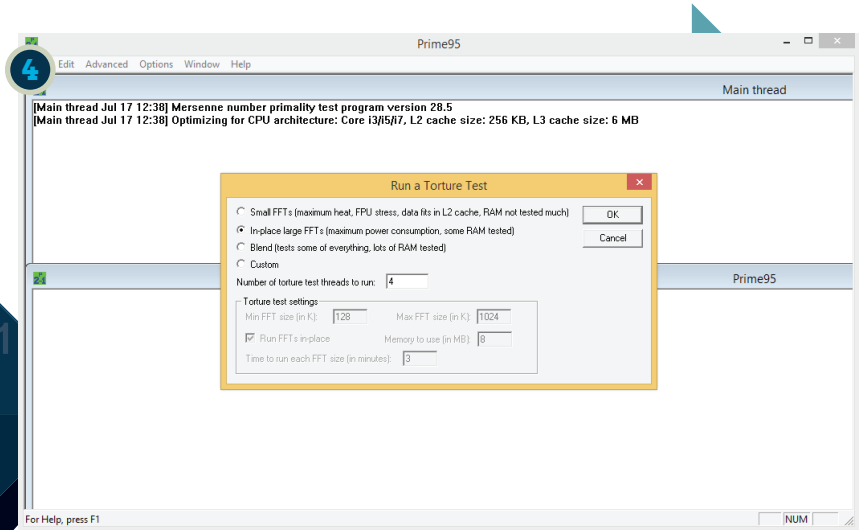
And yes, we'll give the standard disclaimer: Overclocking risks damaging your CPU or motherboard and possibly causing the moon to spin out of orbit, so do this at your own risk. OK, really, it's not that bad but there are always risks, so go into it with your eyes open.

While the system is starting up, mash the Del key to access the BIOS. (You may need to press a different key, depending on your motherboard.) For our MSI Z97 Gaming 7, we go to the "Overclocking Settings" screen and switch from Simple to Advanced mode. For first-timers, a CPU Ratio of 40 is a safe 4GHz overclock **(Image 1)**. Press the "+" and "-" keys to adjust the ratio (some motherboards use Page Up and Page Down instead).

When we push the multiplier past 42x with this particular CPU, its core voltage needs a boost, too. A setting of 1.3V should be fine, up to 4.4GHz **(Image 2)**. We generally don't recommend pushing your voltage past 1.4V, but everything else is fair game. You may also need to increase the power to the motherboard's voltage regulator modules (VRMs). In this BIOS, those settings are in the "DigitALL Power" submenu. Each increment raises your OC ceiling, but it also makes the VRMs run hotter, which impacts stability. We'd stick to tweaking just a couple things like Phase Control and Vdroop Offset, one or two increments at the time **(Image 3)**. If your PC stops booting, you can reset the BIOS itself with a labeled button on the board (the manual has a diagram showing its location).

You can test stability with a free program called Prime95 (http://www.mersenne.org), using its Large FFT torture test **(Image 4)**, accessible from the Options menu. Do this for at least one hour. Some enthusiasts will go a full 24 hours before they consider their OC stable. For Intel, as long as the chip stays at or below 85 degrees Celsius in Prime95, your temperature is fine. When this CPU hits 90 C, it ordinarily kicks into a lower gear to avoid burning up.

Overall, we were pretty happy with this build. The case has a solid feel to it, though we would move the top exhaust fan to the front as an intake. Built-in motherboard standoffs are a nice bonus, and 4.4GHz is a nice overclock for an air cooler with a single 120mm fan.



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Budget AC Router Roundup

Five low-cost 802.11ac routers duke it out

by Paul Lilly

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Early adopters should be allowed to wear a special badge in public. That way, we can identify the brave souls who overpaid for immature technology and thank them for fast-pacing the process of getting next-generation hardware out into the market. Without them, we might still be looking at shelves full of overpriced and buggy pre-draft 802.11ac wireless routers, but that's no longer the case.

Not only has the Wi-Fi Alliance certified the Wireless-AC standard—it's been nearly a year since it happened—but there are now several entry-level 802.11ac routers available at affordable price points. All of them promise varying levels of increased speed over last generation's 802.11n standard, and at far less cost—even factoring in the fact that they lack the bells and whistles of their high-end brethren.

But are there compelling reasons to spend more on a higher-end router versus a budget model, or do they all perform pretty much the same? That's one of the questions we set out to answer, and to do that, we rounded up five low-cost AC routers from Asus (RT-AC52U), D-Link (DIR-818LW), Buffalo (AirStation WHR-1166D), Netgear (R6100), and Trendnet (TEW-813DRU). None of these models cost more than $100 (street pricing) before shipping, but that doesn't mean we went soft on them. We put each one through the same rigorous tests as we do high-end routers. Before we dive into the results, however, we'll go over in detail what you give up by going the budget route.

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What to look for when buying a budget router

USB Slowdown

If you plan on plugging an external hard drive, flash drive, or printer into your router for sharing files or printing over your home network, you'll want to make sure it has at least one USB port. It's even better if your router happens to have a USB 3.0 port, though that's a rare sight in budget territory—every router in this roundup was limited to a single USB 2.0 port (save for one, which didn't have any USB ports), which means slower file transfers from a connected storage device.

Speed Rating

Two of the routers in this roundup are marketed as AC750 models, which means they offer up to 300Mb/s on the 2.4GHz channel and 433Mb/s on the 5GHz channel, while the other three sport AC1200 designations and also offer 300Mb/s on the 2.4GHz channel, but bump up to 867Mb/s on the 5GHz channel. Higher-end routers support faster speeds on both channels—for example, AC1900 routers like the Linksys Smart EA6900 boast up to 600Mb/s on the 2.4GHz channel and 1,300Mb/s on the 5GHz channel. These are all theoretical maximum ratings that are virtually impossible to obtain, but you'll still see speed gains.

Beamforming Blues

Beamforming is an optional feature of the Wireless-AC standard that allows for concentrating a wireless signal directly at a target device (or multiple target devices) rather than shooting it out haphazardly in every which direction. It's akin to shining a flashlight at a specific target versus exposing its light bulb. You can usually forget about beamforming support in the budget category—Trendnet's TEW-813DRU is the only one to support it in this roundup.

LAN and WAN Ports

Virtually all wireless routers these days come with a built-in switch that features four LAN ports. Unfortunately, some router makers still equip lower-end models with 10/100 LAN ports instead of 10/100/1000 (gigabit) LAN ports, and the same goes for WAN. This creates an unnecessary choke point for doling out data, so be sure to pay close attention to the speed rating of both LAN and WAN.

TESTING METHODOLOGY

Maximum PC Lab Midwest

Testing routers isn't rocket science, but it can still be tricky business. These days, we test our routers at Maximum PC Lab Midwest. This consists of a 1,400 square-foot home in the suburbs. It's not an isolated lab environment, but it does allow us to see how routers perform in a real-world scenario.

When the settings allow, we configure each router to run in 802.11n-only mode on the 2.4GHz channel and 802.11ac-only mode on the 5GHz channel, both with WPA2 encryption and channel-bonding. More often than not, it isn't possible to place such tight restrictions on each channel—some will only let you set limits to N+AC, for example—so in those cases, we let the router's Auto settings configure itself for best performance. Depending on the results, we sometimes step in and manually select the best channel, which is something we can determine using Metageek's inSSIDer tool ($20, www.inssider.com).

We perform these speed tests in five separate locations, including three inside tests and two outside tests. These include the Bedroom (10 feet from the router, no obstructions), Dining Room (15 feet, 2 walls of separation), and Entryway (20 feet, 3 walls), followed by the two outside tests consisting of the Driveway (35 feet) and Backyard (90 feet).

To measure throughput at each location, we run the open-source Jperf utility, which is a GUI front end for Iperf. For these tests, we hard-wire a desktop to the router to act as the Server, and use a laptop equipped with a Linksys USB6300 dual-band AC USB adapter for the Client PC. And if applicable, we wrap things up by measuring file transfer performance from each router's USB using a Lexar JumpDrive P10 USB 3.0 flash containing a 3GB file and 1GB folder containing several smaller files.

Since this is a roundup of budget routers, we're looking for speed relative to price. That's to say, we don't expect an $80 AC750 router to perform the same as a $250 AC1900 router. At the same time, we do expect to see speed gains over the 802.11n standard, otherwise there really isn't any point in purchasing an AC router.

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ASUS RT-AC52U

Hobbled by a bipolar 5GHz band and 10/100 WAN port

ASUS TOOK THE SPEED crown in three of our four file transfer tests, though this was a four-way fight to find out which one was best over USB 2.0—none of the routers evaluated here brought a USB 3.0 port to the party, and Buffalo's router didn't bring any USB ports at all. Still, it's not a hollow victory if you plan on transferring files over a USB connected drive.

Unfortunately, the RT-AC52U struggles where it matters most in this roundup, and that's 802.11ac territory. Not matter what we tried, we couldn't coax a reliable signal from the 5GHz band, which would inexplicably enter a comatose state at random intervals. To make matters worse, Asus equipped the RT-AC52U with a 10/100 WAN (and the same goes for its LAN ports). This pretty much negates jumping on the 802.11ac bandwagon.

Performance on the 2.4GHz band in 802.11n mode was solid and surprisingly strong in our Backyard test where it benchmarked 18.9Mb/s for a first-place finish. We're also impressed with RT-AC52U's sleek and streamlined interface. It's easy to navigate and overflowing with advanced settings for experienced networking gurus to play with.

Perhaps a future firmware update will alleviate the issues we experienced on the 5GHz band. Until then, there are more reliable models to choose from, albeit all more expensive than this one.

VERDICT **5**

Asus RT-AC52U

$69 (street), www.asus.com

The RT-AC52U's aggressive styling is marred by a wonky 5GHz band that struggles to maintain a connection.

D-LINK DIR-818LW

Style meets substance

RELEASED IN MAY OF THIS YEAR, the DIR-818LW is available in red, teal, black, and white, each of which runs about $80—a solid price point for what you get. All of them borrow from their bigger brother's cylindrical shape, which itself looks like a miniature Mac Pro. The DIR-818LW, however, is more compact and would fit comfortably in a suitcase.

Unfortunately, looks are only skin deep and don't carry over into the DIR-818LW's nerdy interface. There are five main hyperlinked categories, each of which brings up a set of subcategories on the left-hand side, and it's all very wordy and drab, not at all like the router's physical appearance. This is a step back from the overhauled dashboard D-Link rolled out for its DGL-5500 Gaming Router (reviewed in our April 2014 issue).

D-Link came out swinging and gave Trendnet a run for its money on the 802.11ac radio, at least at close distances. The lack of beamforming support ultimately gave the edge to Trendnet, though the DIR-818LW has nothing to be ashamed of here—it pulled 233Mb/s in the bedroom and 150Mb/s in the Dining Room test while every other router save for Trendnet's never crossed above 100Mb/s in either benchmark.

D-Link's new routers strike a balance between looks and performance.

VERDICT **8**

D-Link DIR-818LW

$80 (street), www.dlink.com

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BUFFALO AIRSTATION WHR-1166D

Too stripped down to take seriously

IT'S A GOOD THING you can find Buffalo's AirStation WHR-1166D selling online for around $80, because the $150 MSRP is almost insulting for such a stripped-down router. To begin with, the internals are still based on Draft 2.0 specs. Perhaps Buffalo hasn't gotten around to submitting this model for official certification, and if that was the router's only shortcoming, we'd be more inclined to give Buffalo a pass. However, we have other grievances, such as the nerfed LAN ports (10/100 instead of 10/100/1000) and lack of USB connectivity.

We couldn't evaluate file transfer performance over USB, but we were able to test 802.11n and 802.11ac throughput. At close range, the AirStation settled for last or second-to-last place finishes in our three inside tests on the 802.11n radio. And on the 802.11ac radio, Buffalo never threatened a victory, though it held its own in the Driveway with the second highest throughput (16.4Mb/s). However, the Backyard test broke its back, just like it did for pretty much all five routers in this roundup.

The web interface won't intimidate novices and is touch-friendly, to boot. It could use some more fleshing out, but still offers a decent amount of fine-grain control. That said, we found it odd that the router password can't be longer than eight characters—what's up with that?

VERDICT **5**

Buffalo AirStation WHR-1166D

$80 (street), www.buffalotech.com

No USB connectivity for you!

NETGEAR R6100

Middling performance with above-average range

NETGEAR'S HIGH-END ROUTERS are some of the fastest and most feature-rich around, but in the budget category, it seems Netgear is content to blend in with the competition. That's not necessarily a bad thing—the R6100 only costs $90—though we're disappointed Netgear chose to roll with 10/100 WAN and LAN ports instead of 10/100/1000. We can't imagine gigabit ports cost much more.

When we tested the R6100 on the 2.4GHz band, it hit 79.7Mb/s at close range and only dropped to 75.6Mb/s in the Dining Room. That's respectable, though not exceptional. More impressive is that it had the range to post a second-best score in the Backyard test (17.3Mb/s at 90 feet away).

On the 5GHz band in 802.11ac mode, the R6100 hovered around 94Mb/s in the Bedroom, Dining Room, and Entryway. Outside in the Driveway, performance dipped to 13.8Mb/s for a third-place finish, and it was the only router to maintain a signal in the Backyard, albeit a weak one at 2.49Mb/s.

Netgear's dashboard is another one that seems tuned for touch input with tiles on the main screen and big buttons on the sidebar. It's easy to find what you're looking for, though if we had our druthers, we'd plop the QoS controls under the Advanced Setup menu rather than the standard Setup menu—but hey, at least it has them!

The R6100 can hold a signal at long range despite the lack of high-power, external antennas.

VERDICT **7**

Netgear R6100

$90, www.netgear.com

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TRENDNET TEW-813DRU

The best of these budget routers

THE ONE ROUTER THAT STOOD OUT in this roundup is Trendnet's TEW-813DRU. It also happens to be the most expensive at $95 street, plus about another $10 for shipping, but that's still C-note territory and you get best-in-class performance and beamforming support.

Only D-Link threatened Trendnet for pole position on the 802.11ac track, and though it stayed within striking distance at close range, Trendnet sprinted ahead the further away we benchmarked them—clearly a result of beamforming. When the smoke from the tires settled, Trendnet had won the race in all five tests. It performed especially well at relatively close range: 242Mb/s in the bedroom, 165Mb/s in the Dining Room, and 159Mb/s in the Entryway.

The TEW-813DRU also posted some of the fastest scores on the 802.11n radio, and its file transfer performance over USB was pretty good for the most part, though not as fast as Asus's RT-AC52U. Had Trendnet opted for a USB 3.0 port, this could have been a good old-fashioned beat-down like a young Mike Tyson used to dole out.

Even the web interface is fast. It responded quickly to our navigational clicks, and the layout is both user-friendly for networking novices and deep enough to satisfy more experienced users who might want to configure things like inbound filters, multiple SSIDs per channel, and more.

VERDICT **8**

Trendnet TEW-813DRU

$95 (street), www.trendnet.com

If you're on a budget, this is the entry-level 802.11ac router you're looking for.

SPECIFICATIONS

	Asus	D-Link	Buffalo	Netgear	Trendnet
802.11n	300Mb/s	300Mb/s	300Mb/s	300Mb/s	300Mb/s
802.11ac	433Mb/s	433Mb/s	867Mb/s	867Mb/s	867Mb/s
Antenna	Internal (x3)	Internal	Internal (x2)	Internal (x4)	Internal
Firewall	Yes	Yes	Yes	Yes	Yes
Guess Access	Yes	Yes	Yes	Yes	Yes
Parental Controls	Yes	Yes	Yes	Yes	Yes
QoS	Yes	Yes	No	Yes	Yes
LAN	10/100 (x4)	Gigabit (x1)	10/100 (x4)	10/100 (x4)	Gigabit (x4)
WAN	10/100 (x1)	Gigabit (x1)	Gigabit (x1)	10/100 (x1)	Gigabit (x1)
USB	USB 2.0 (x1)	USB 2.0 (x1)	No	USB 2.0	USB 2.0

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Are Budget Routers Worth the Price?

PICKING A CLEAR WINNER in any roundup is rarely easy, though in this case, Trendnet leaves little room for dispute. The only real negative is that the TEW-813DRU costs the most. However, we're only talking about a $15 difference over the other viable candidates, and beamforming support alone is worth the small premium—it's no coincidence that Trendnet's entry was the fastest overall, especially in the 802.11ac space where the signal is highly sensitive to obstructions.

We'd give Asus props for undercutting the competition on price with a street cost of just $69, but it's negated by having 10/100 WAN and LAN ports, which hold the router back. And on top of that, the 5GHz channel was extremely spotty, both in our benchmarks and real-world tests. We routinely saw downloads on the 5GHz channel fluctuate in speed and drop out altogether.

We also had high hopes for Netgear's R6100, but like Asus's model, the router is hindered by limiting both LAN and WAN ports to 10/100 instead of gigabit. That doesn't have to be a deal-killer in the budget space, but it's certainly a clear reminder of why these models cost so much less than their high performing counterparts, and the performance benchmarks bear that out.

That leaves Buffalo and D-Link. Buffalo gets an early dismissal for its overly feature-poor approach and slow 802.11n performance, while D-Link is a solid choice. Though there's no mention of beamforming support, D-Link's DIR-818LW gave Trendnet's unit a run for its money at close range, at least on the 802.11ac channel. However, it couldn't keep up at distance runs, and its 802.11n performance trailed far behind Trendnet.

None of these routers have what it takes to compete with much more expensive models, but if you're just looking for a modest speed increase, you have a few inexpensive options.

BENCHMARKS

5GHz 802.11ac	Asus	D-Link	Buffalo	Netgear	Trendnet
Bedroom – 10ft	91.6	233	94.7	94.3	**242**
Dining Room – 15ft, 2 walls	81.5	150	94.4	94.5	**165**
Entryway – 20ft, 3 walls	94.7	66.5	93.4	93.8	**159**
Driveway – 35ft	1.45	9.94	16.4	13.8	**48.5**
Backyard – 90ft	N/A	N/A	N/A	2.49	**2.99**

5GHz 802.11ac	Asus	D-Link	Buffalo	Netgear	Trendnet
Bedroom – 10ft	94.4	88.8	94.1	94.3	**167**
Dining Room – 15ft, 2 walls	82.7	63.8	74	**90.2**	83.5
Entryway – 20ft, 3 walls	75.2	64.1	56.4	**90.2**	68.1
Driveway – 35ft	39.1	1.84	40.7	**49**	29.8
Backyard – 90ft	**18.9**	N/A	6.45	17.3	1.38

5GHz 802.11ac	Asus	D-Link	Buffalo	Netgear	Trendnet
3GB Router to PC	**4min 29sec**	4min 55sec	No USB	8min 21sec	5min 10sec
1GB Router to PC	**1min 42sec**	3min 40sec	No USB	1min 58sec	2min 48sec
3GB PC to Router	4min 47sec	**2min 50sec**	No USB	6min 25sec	7min 24sec
1GB PC to Router	**2min 24sec**	11min 55sec	No USB	7min 35sec	4min 54sec

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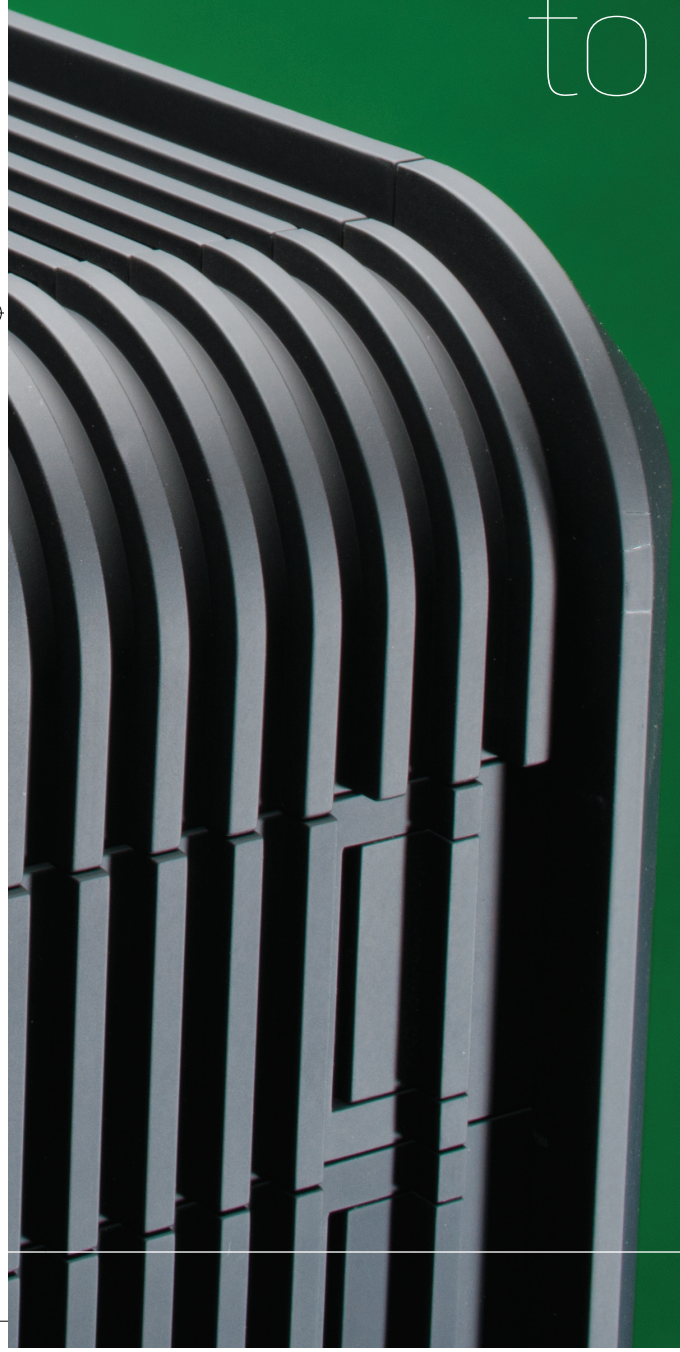
LOW-RENT RIDES

by David Murphy

Budget doesn't have to mean junk



Cheap cases. They're not as scary as the phrase implies, even though we acknowledge that the lower end of the case spectrum can deliver some real clunkers. Thankfully, none of the cases in our roundup this month fit that profile. In fact, we're seeing a number of features previously reserved for pricier cases start to grace more inexpensive models.

Think about it: Cases, under $100, designed specifically for liquid cooling? We've always felt that someone willing to plunk down hundreds of bucks for top-quality liquid-cooling parts—and suffer the hours of setup (and soggy components) that can come from one's adventures in liquid-cooling land—would want to pick up a more expensive case to accommodate their build. Not anymore! One of the cases in our roundup practically screams "stash a radiator in me."

Of course, not all is perfect in the world of computer chassis. It's tough to find that diamond in the rough—a case that comes with all the features we think you should have, and only a few (or no) annoyances. None of the cases in our roundup fit that profile, but a few come quite close. Give them a read; perhaps you'll find that you can deal with their imperfections for their oh-so-low prices.

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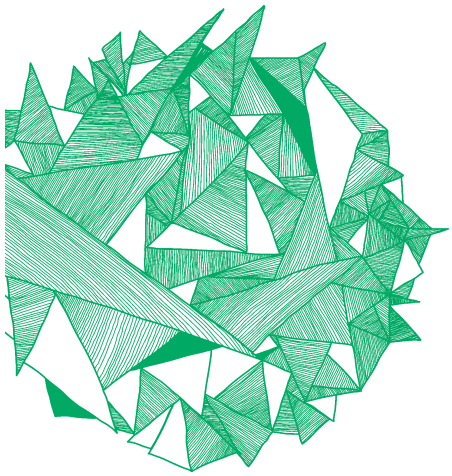
What Makes a Great (Cheap) Case



We teased the concept of "a diamond in the rough," so it's time to shine a light on all the facets that make a cheap chassis sparkle. There's not that much, but you'd be surprised at the little details that make for a more pleasurable building experience when cases get them right, versus when they don't.

First up, we're big fans of cases that use as few normal screws as possible. We don't like having to bust out the screwdriver to install parts and pieces if we can avoid it. Fewer screws also usually means fewer parts to lose once the build is done. Thumbscrews are much preferred if screws have to be used at all, but we love cases that use simple locking mechanisms for add-in cards, the case's side panels, and 5.25-inch devices (preferably, 5.25-inch bay locking mechanisms that you can remove, as some two-bay devices won't play nicely in these situations).

As for hard drives, we like either trays or rails. We're slightly biased toward the former, especially if they allow one to mount 3.5-inch hard drives or 2.5-inch SSDs in a typical 3.5-inch bay. That said, we're not opposed to cases that do things a little differently—like, say, building in a combination mount that allows you to switch a chunk of bays between supporting 2.5-inch or 3.5-inch drives.

The popularity of SSDs and price drops have meant that even cheaper cases are starting to include "hidden mounts" for 2.5-inch drives behind one's motherboard tray. The more the merrier, we say; you can never have enough secret storage.

Ample cable mounting holes are a key part of today's cases. We need to see at least two big chunks taken out of the motherboard tray to the right of the motherboard itself, as well as one near the power supply. Up top, we'd really prefer a tiny, easy-to-access hole to string our 12V through.

We have no opinion on a case's materials per se, so long as the case has been designed so that there aren't any pokey, sharp edges—bleeding on one's PC is never fun, as this writer learned from his time in the Maximum PC Lab. Aluminum or steel is fine. Even a case with all sorts of plastic trappings on the outside is OK, so long as it looks good. What we find ugly, you might love (and vice versa).

Fans play greatly into a case's cooling *and* aesthetics. Where possible, we prefer larger fans (less noise, more air), or at least ample opportunities to stash 12cm or 14cm fans in the same mounting spot — in case you only have the former, but want to upgrade to the latter later. Fan controllers are starting to creep into cheaper chassis; where possible, we'd like the ability to control more fans than just what a case typically comes with (two, in most bare-bones setups). Dials are great, but we'll accept a "low, medium, high" switch—or even just a two-speed setting.

Chassis can come with all sorts of unique little twists on conventional building—sometimes they work, sometimes they don't. In general, these are the kinds of things we look for in an awesome case (but we definitely don't say no to crazy extras, like hotswap mounts for one's hard drives). A good computer case is kind of like the Supreme Court's definition of pornography: You'll know it when you see it.

The Cooler Master N600 isn't perfect, but it has a number of the features we look for in a standout budget case.

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Zalman Z12 Plus

More SSDs! More fan control!

When's the last time you used more than one or two 5.25-inch devices?

SIMPLE. EASY. EFFECTIVE. We're big fans of most of what Zalman does with its Z12 Plus chassis. Its price feels a bit high for what it offers but, on the plus side, there's nothing about the chassis that's a deal-breaker.

The plastic-and-steel mid-tower case comes in at just around 15.5 pounds in weight, making it a pleasant but not overbearing foot-and-a-half-tall chassis for stuffing under (or on) your desk. We had no issues removing its windowed side panel (thumbscrews) and throwing in a motherboard, save for the curious omission of three of the bottom standoffs (which you have to install yourself).

Our test video card, an (aging) Nvidia Geforce GTX 480, fit without issue in the Z12 Plus. While it did cover a bit of one of the Z12 Plus's four cable management holes, Zalman's design offers a little breathing room between the 10.5-inch card's edge and the start of the 5.25-inch bays.

Installing hard drives into the case's five standard 3.5-inch bays (and one 2.5/3.5/5.25-inch conversion bay) isn't a screwless process, but it's still simple: Four screws and four rubber anti-vibration rubber grommets go directly into your hard drive's mounting holes. Slide the drive into one of the bays, and a preinstalled locking mechanism catches the screws and holds your drive in place.

Any 5.25-inch devices you want to stash into the case's four standard bays require the normal screw treatment; you also have to pop off the case's front panel, which features a small amount of sound-dampening foam over all its mesh sections. Curiously, the thin bay covers that one normally just twists off of a case are actually screwed into the Z12 Plus. We're not quite sure why that's necessary, and it does add an extra step to an otherwise easy installation.

The case comes with three fans preinstalled: a 12cm front blue LED fan, a similarly sized (and colored) top LED fan, and a 12cm rear fan (no lights). Presumably, Zalman wants you to hook the two LED fans into the provided connectors for the case's high/low fan controller. If you're big on looks, know that adjusting the voltage of the fans is also going to adjust the brightness of the LEDs.

Rounding out the Z12 Plus's attributes are four USB ports (two USB 3.0 on top; two 2.0 on the lower-right of the case's front), a hidden installation point on the rear of the motherboard tray for one 2.5-inch drive, and two rubberized holes for water-cooling tubes on the case's rear.

The Z12 Plus is a no-nonsense kind of a case. While we wish we had more room for 2.5-inch drives, and want to hook up more fans to its built-in controller than it allows by default, these issues don't significantly detract from the case's quality. Unless, of course, you're looking to stash a ton of SSDs in your new system.

VERDICT 7

Zalman Z12 Plus

+ Good amount of space; great cable management; ample 3.5-inch slots.

− Limited SSD support; would prefer drive rails over screws; a few too many 5.25-inch bays for our liking.

Price: $90, street

Cooler Master N600

Great for liquids, not for air (or SSDs)

WE APPRECIATE THE SHEER versatility of Cooler Master's N600 chassis. It's not a case we'd give to beginners, but those of you who don't mind rolling up your shirt sleeves when installing your mid-level system will mostly enjoy your time spent.

Our major dissatisfactions with the case were cosmetic, though you'll want to focus on fixing them up given the giant, acrylic window on the case's side panel. The case's cooling is adequate, but not overly impressive: a single, non-LED 12cm fan on the rear, and a single, white LED 12cm fan preinstalled on the case's front. A built-in fan controller allows you to run the two fans at a low or a high setting; doing so affects the brightness of the front LED fan. (You can also switch the LED fan's light on and off via a hard-to-push switch on the case's front). The front LED fan doesn't provide nearly as much light as we'd hoped for. A rear LED fan to boost the lighting would have been much preferred. Our front LED fan was also a bit loud on its high setting, more than we'd want to hear under our desk.

Fatter fans, more hidden SSD mounts; our requests are simple.

The case's three 5.25-inch drive bays are entirely screwless—we like. The case also comes with three 3.5-inch drive bays built into the chassis, but supports an additional four more, depending on how you set up an additional 3.5/2.5-inch "combo cage." You can't have both, however; set the cage up for SSDs, and you're limiting yourself to just three 3.5-inch hard drives. Go for seven 3.5-inch drives, and the only other place you can install an SSD is via a two-screw fixture on the rear of the motherboard tray.

The combo cage, which faces front-to-back, can be completely removed if you value cooling over storage. Do that, and you can attach a 24cm radiator to the case's right side (there's also space for a 24cm radiator on the case's inside-top, and room for a smaller 12cm radiator on the rear). However, we do wish that Cooler Master carved out more room for SSDs; you can't convert the existing 3.5-inch bays into 2.5-inch bays, and we'd hate to be stuck with one SSD slot if we liquid-cooled.

We also wish Cooler Master had carved an additional rubberized hole in the motherboard tray for cable stringing, as our GTX 480 video card blocks the top half of the tray's middle hole (of three total). On the plus side, the cables to the front-panel connectors (including its two USB 2.0 and two USB 3.0 ports) are nice and long, which helps cable management a bit.

We wouldn't try to stuff our top-shelf system into this case, but the N600 makes for a good middle-of-the-road chassis; we love the support for liquid cooling, just not the built-in air.

VERDICT **8**

Cooler Master N600

+ Plenty of space for 3.5- and 2.5-inch hard drives; very liquid cooling–friendly; lots of USB ports.

− Poor case lighting; a bit loud when fans cranked up to "high;" could use another "hidden" SSD mount or two.

Price: $80, street

We love the side-panel window's tinted, arrow-like look.

Rosewill Blackhawk

Let's play whack-a-Molex

WE ENJOY MOST OF WHAT Rosewill has done with its $100 Blackhawk case. Many of the design features are what you'd likely see in more expensive chassis, but there are a few areas where Rosewill appears to cut corners—or just misunderstand solid case design. At the price you're paying, you could do better.

The case's tinted, arrow-shaped side panel window looks lovely; it's a refreshing change of pace from the simple clear acrylic we often see. On the inside, we love that Rosewill includes a Velcro strap to secure your power supply to the case (and reduce noise and vibration). Standoffs come preinstalled for an ATX motherboard, and the tray itself has five rubber holes for cable management.

When you put a motherboard in, however, it mostly covers the tiny hole Rosewill sticks in the tray's upper-left corner—presumably designed to stuff a 4- or 8-pin ATX12V connector through. You'll either have to really wedge that cable around your motherboard or you'll have to shoot it across your motherboard from one of the right-most rubber holes, which is hardly a good-looking solution.

The case's three drive bays (two drive trays each, which support 3.5- and 2.5-inch drives) can be removed in various configurations, should you be sporting an extra-long video card or want to try and slap a 24cm radiator in the front of the chassis (occupied by two 12cm blue LED fans). A 14cm blue LED fan sits on the case's top, joined by a 12cm fan on the case's rear and side (both non-LED). If that sounds like a lot of cooling, it is; the case is at about a medium level of noise when they're all fired up, though the blue glow looks great through the case's side window.

Unfortunately, only one of the fans uses a three-pin connector. The rest all use Molex connectors for power, which means that you have no way of actually controlling their speed without an adapter of your own. In a system that runs five fans out of the box, a fan controller (or some way to control volume/speed) would be much preferred.

Installing a 5.25-inch device is seemingly easy, though we had trouble getting our optical drive into the top of the case's four free bays. The wiring for the Blackhawk's (awesome) front-panel connectors—four USB 2.0 ports, two USB 3.0 ports, and a hotswap SATA connection—got in the way of our optical drive, and it took a lot of wedging to get the wires into the case's top and our optical drive into place. Locking it in was easy.

Rosewill's Blackhawk offers plenty of space for building, and installing a system into the case isn't that problematic. Added together, however, this case's minor flaws start to make its price look all the larger.

VERDICT 6

Rosewill Blackhawk

+ Lovely tinted window; plenty of air cooling; SATA hotswap; great aesthetic.

– Decent amount of noise; no fan controller; most fans use Molex; top 5.25-inch bay difficult to work with.

Price: $100, street

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Enermax iVektor

Stylish and low cost, to boot

ENERMAX'S IVEKTOR MIGHT get the company sued by Apple. In the meantime, you owe it to yourself to give this svelte, smooth mid-tower chassis a try. Minus a little airflow, which we're happy to upgrade, this inexpensive chassis offers much.

After popping off the tinted, windowed side panel (thumbscrews), we first noticed just how roomy the seemingly small iVektor actually is. Motherboard standoffs come preinstalled, and the case's right-most combination drive bracket is preconfigured to support four 2.5-inch drives. Unscrew its left-most support and move it to the 3.5-inch configuration, and Enermax says you can stuff three 3.5-inch drives in the space. We installed four, and the entire configuration still gave us a smidge of room between the bracket and a 10.5-inch long video card. Three fixed drive bays below the aforementioned bracket support 3.5-inch drives only, and there's no other place to stash an SSD unless you configure said bracket into 2.5-inch bays. Spring-loaded covers on the front panel can be removed without popping the panel off, which makes installing devices into the case's three 5.25-inch bays a breeze.

This case feels as soft to the touch as a small, baby bunny.

A very tiny cable-management hole in the motherboard tray's upper-left corner doesn't leave much to work with for your system's 4- or 8-pin ATX12V connector. Two holes to the right of the motherboard are much larger, as is the giant hole to the right of where one stashes the power supply. The space between the rear of the tray and the motherboard's side panel is ample, more so than most cases we've looked at—happy cable stuffing!

The case's add-in card brackets use real screws, not thumbscrews, so get ready to bust out the tools to install your add-on cards. It's a mild letdown, but Enermax's insistence on providing rails for both one's 3.5- and 2.5-inch drives makes up for it. A bigger annoyance is the system's cooling: a single 12cm blue LED fan in the front and a 12cm fan in the rear. They're both wired to a "high, nothing, or low" fan controller whose switch sits on the top of the case near its two USB 2.0 and two USB 3.0 ports.

Thanks to foam padding that covers the case's mesh parts, the iVektor is very, very quiet when the fans are on "low." You'll give up airflow on low, though. Kick the fans up to high, and you're increasing the volume to a slightly more noticeable amount. It makes us wish Enermax opted for 14cm fan mounts instead—the price one pays for a smaller-sized chassis.

Enermax's iVektor might not be perfect, but it's smooth—literally. A lovely external aesthetic, spacious interior, and ample drive support almost makes us forget a few of its tiny flaws.

VERDICT **8**

Enermax iVektor

+ Lots of space on the inside; ample USB connectivity; good cable management; plenty of drive bays.

− Cooling so-so; lacks motherboard-tray mounts for SSDs; normal screws (not thumbscrews) for PCI slot covers.

Price: $80, street

No more Michael Bay–designed cases, please.

Enermax Coenus ECA3190A

More than meets the eye? No, not really

ENERMAX'S COENUS CHASSIS (specifically, the ECA3290A) copies a number of features from the company's iVektor lineup (reviewed on previous page). Or perhaps the iVektor was an upgrade from the Coenus. Regardless, the things we liked about the iVektor continue to work in the Coenus's favor. However, a few less-than-ideal differences allow the iVektor cases to leave their Coenus peers in the dust.

Beauty is in the eye of the beholder, but we're not big fans of the chunky, gray plastic paneling that Enermax slaps all over the front and top of the ECA3290A. It looks a bit like a child's toy enlarged to extreme proportions; the case's front reminds us of a Transformer logo, and it makes the whole aesthetic look a bit juvenile. It's the kind of look we'd go for if we were building a system for a middle-schooler (or a late-blooming college student).

The case's insides are great to build in: Motherboard standoffs come preinstalled, all drive bays come with rails for easy installation (three 3.5-inch, and a combo bracket that fits four 2.5- or 3.5-inch drives), and the case's 5.25-inch bays use a handy locking mechanism to secure your devices. You get two cable-routing holes on the side of the motherboard tray and one larger one to the right of where the power supply goes. More importantly, there's a ton of room behind the motherboard tray for your cables; stash away!

The tiny cable-management hole in the tray's upper-left corner for your 4- or 8-pin ATX12V connector can be a little tricky to work with, but it's manageable. The case's add-in card slots all use screws, not thumbscrews, so you'll definitely need a screwdriver on hand to complete your system build. Unfortunately, the ECA3290A doesn't use the fun spring-locking 5.25-inch bay covers found on its iVektor cases, so you'll have to pop off the front paneling completely just to install your optical drive (or what-have-you).

The ECA3290A only comes with two USB 3.0 ports; the iVektor has those *and* two extra front-panel USB 2.0 ports. It also has more foam covering its mesh areas on the case's front and top, which helps reduce the noise of its front and rear 12cm fans a bit. The ECA3290A comes with the same fan configuration, sans the iVektor's fan controller, so there's no way to quiet them via the case itself. That said, we're talking about fairly minor acoustic differences—nothing that made us want to cover our ears.

All in all, the Coenus and iVektor cases hover right around the same price point (depending on where you're shopping). We'd rather take our money to the better-looking, better-performing iVektor chassis. Leave this little Coenus cousin behind.

VERDICT 6

Enermax Coenus ECA3190A

+ Lots of space on the inside; good cable management; plenty of drive bays.

– Only two USB ports; horrible external look; no fan controller; must remove front panel to install 5.25-inch devices.

Price: $70, street

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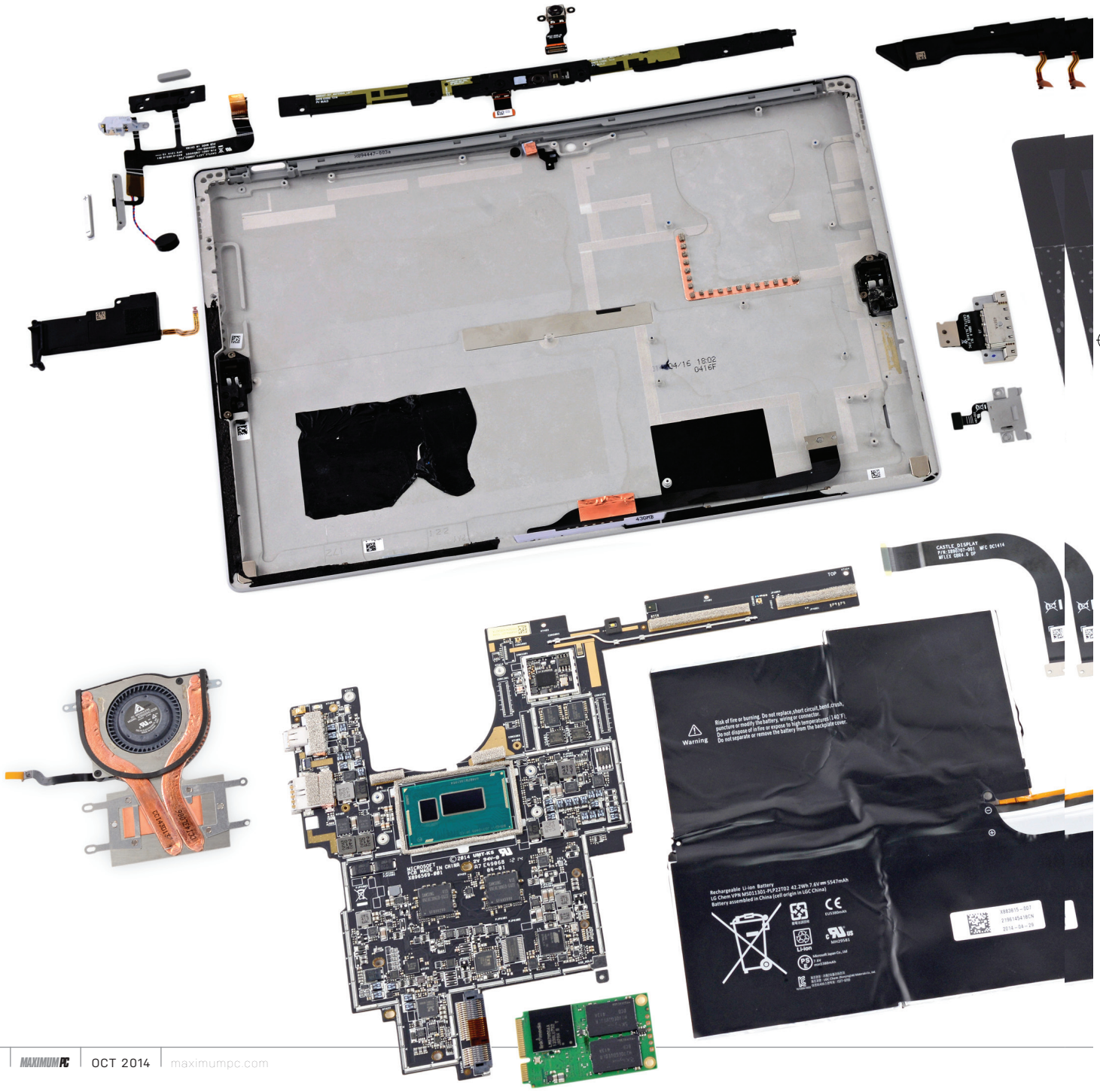
IFIXIT presents:

AUTOPSY

THIS MONTH WE DISSECT...

Surface Pro 3



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BACKGROUND:

The Surface Pro 3's beauty isn't just skin deep—or is it? It's not entirely clear if what holds the ultra-thin hybrid's innards together is black magic, or just another black substance at work.

MAJOR TECH SPECS:

(Core i5, 128GB SSD, 4GB RAM model; other options available)

- 12-inch ClearType Full HD Plus IPS LCD with a resolution of 2160x1440 pixels
- Fourth-generation Intel Core i5 Haswell chip
- Marvell 88W8897 WLAN (802.11ac/802.11 a/b/g/n) plus Bluetooth 4.0
- SK Hynix HFS128G3AMNB 128GB mSATA 6Gb/s SSD
- Samsung K4E8E304ED-EGCE LPDDR3 RAM
- 5.0 MP/1080p front- and rear-facing cameras
- Full-size USB 3.0 port, microSD card reader, and Mini DisplayPort
- Dolby speakers
- 42.2 Wh, 7.6 V, lithium-ion battery

KEY FINDINGS:

- Even taking extra care when heating and prying up the screen's glass wasn't gentle enough: The cooling adhesive alone was enough to crack the display's surface on our photo table.
- Hugging the back of the display is an N-trig DS-P4196 touch controller.
- Microsoft has added a 150-degree angle option to the kickstand, allowing the Surface Pro 3 to lay nearly flat.
- The status LED and microphone live right next to the rear-facing camera.
- Something new: a springy metal bracket pinning the display connector in place.
- Sticky, gooey adhesive is everywhere.
- The cooling system is more akin to one found in a laptop than a tablet, and uses one-half the fannage of its predecessors.
- Beneath the heatsink we find the CPU, but it's not coming off the board.
- Repairability Score: 1 out of 10 (10 is easiest to repair). So much is crammed into so little space, resulting in a high potential for damage during every major step of disassembly, even with some parts being replaceable. The SSD can be replaced, but not without first risking damage to the tablet simply by opening it. The battery is not soldered to the motherboard, but very strong adhesive makes removal and replacement a hazardous chore. Added to that is the incredible difficulty in removing the display, with its non-standard connectors, a fused glass panel/LCD that's incredibly tricky to remove and replace, and an insanely delicate opening procedure that has no wiggle room for mistakes. Any DIY fixes become a dicey proposition.

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

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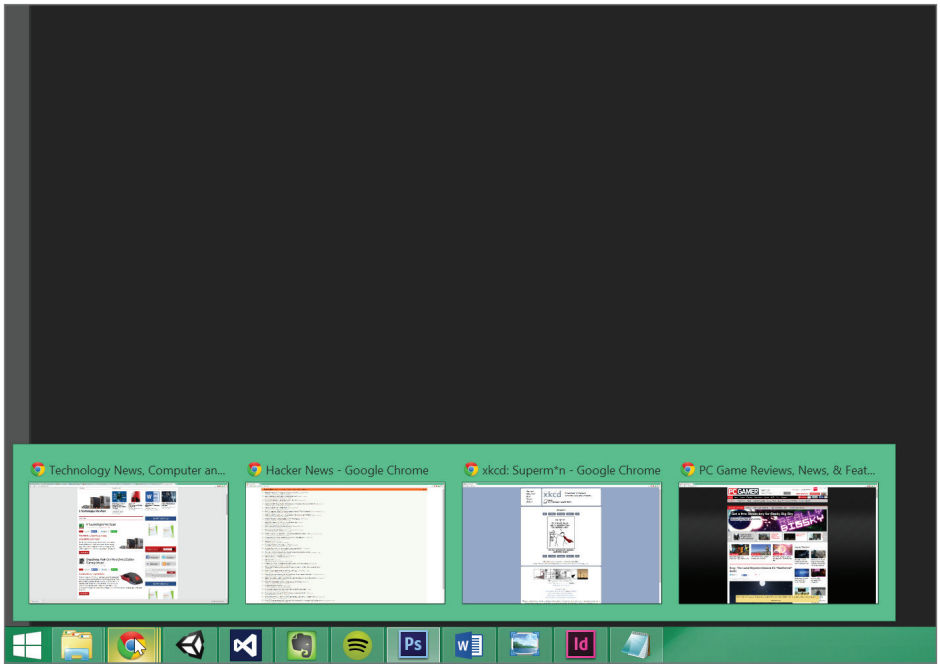
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

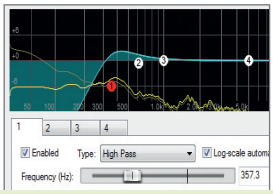
WINDOWS TIP OF THE MONTH



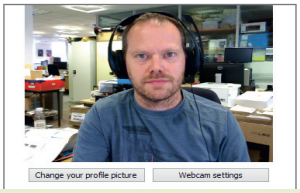
USE HOTKEYS WITH THE WINDOWS TASKBAR

Did you know that you can use hotkeys to change how the taskbar behaves? If you hold down the shift key before clicking a program icon, you'll open a new instance of that program. If you hold down Ctrl, you'll open the most recently used instance of that program. Hold Ctrl + Shift and click to open a program as an administrator.

MAKE – USE – CREATE



66
Clean Up Recorded Audio



68
Stream Gameplay with Raptr

ALEX CASTLE
CONTRIBUTING EDITOR

SCREEN CAPTURES, THE RIGHT WAY

AS A TECHNOLOGY WRITER, I find myself taking screenshots all the time. Over the years I've found a few simple ways to make the process much easier and more efficient. Even if you only occasionally need to do a screen capture, try out these three tips.

GET A UTILITY: The built-in Windows screen grabber has gotten a lot better over the years, but it's still nowhere near as good as a dedicated screenshot application like Greenshot, which you can get for free at www.getgreenshot.org.

SET A TIMER: If you're trying to capture a fiddly UI element, like a rollover window, the screenshot button can screw things up. Greenshot lets you set a timer so you can hit the button, and have the screenshot automatically taken a few seconds later.

CROP LATER: I've learned that the fastest way to take screenshots is usually to snap full-screen. You have to crop after the fact, but it saves you from the irritation of accidentally capturing the wrong window.

↘ submit your How To project idea to: comments@maximumpc.com

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Clean Up Recorded Audio

YOU'LL NEED THIS

REAPER

This article is describes how to process audio with Reaper, but the underlying techniques will work in other software. Download the Reaper evaluation at www.reaper.fm.

A LOT OF THINGS CAN RECORD audio these days—phones, cameras, laptops, video-making devices—and probably top-of-the-range microwave ovens, too. But unless you've got the latest dictaphone or microphone, the emphasis on a product's design is usually thrust upon its other features, such as video quality and speed. These gadgets may be capable of providing crystal-clear HD image quality, processing multiple terabytes of information in a second, and making top-notch toast, but the audio you get out of them may leave a lot to be desired.

But there's often a digital solution for poor-quality off-the-cuff recordings, and the good news is that you will usually have more time to put into correcting audio files than you had to prepare for the recording itself. Yes, help is at hand from algorithms, as many have been designed for the tricky business of restoring decaying archive tapes and remastering classic records. In this guide, we'll show you how to use basic audio-processing techniques to greatly improve any audio. **–JAMES RUSSELL**

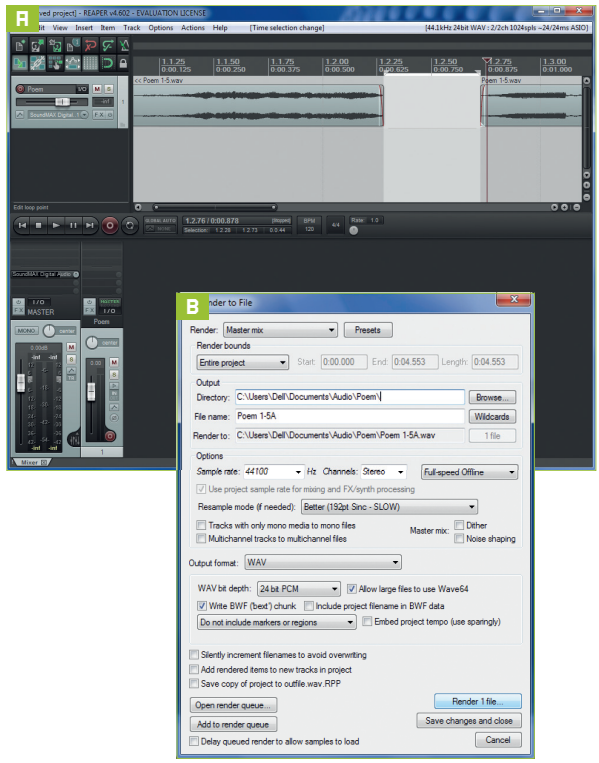
1 INSTALL AND CONFIGURE REAPER

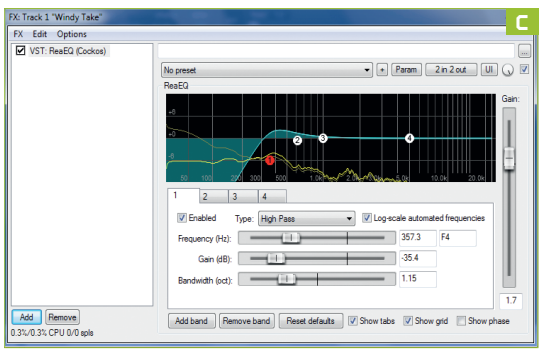
The examples in this article are written using Reaper, which is paid software, but you can get an evaluation copy from www.reaper.fm. Note that these techniques are not Reaper-specific, though—any capable audio-processing software, such as the free Audacity, should be capable of most or all of these functions.

» Once you've downloaded and installed Reaper, open it and drag some audio from Explorer onto the timeline. A new channel will appear along the bottom row, next to the Master (output) channel. You can use the magnifier by the horizontal scroll bar to zoom into the audio file as far as necessary.

» Use the magnet icon, or Alt + S, to disable "snap to grid." This will allow you to select a custom area by clicking the timeline above the audio region. Ctrl + Del will chop out an area (**Image A**). You can loop your selected timeline region with the green button to the right of the play button. Click an audio channel's FX button for a list of plug-ins to lay over the track.

» After any changes, the original audio file remains the same. To commit the changes made in Reaper, go to File → Render or press Ctrl + Alt + R to bring up the Rendering options (**Image B**). You can render the entire file or selected portions on the timeline. The default settings will be appropriate, so click on the "Render 1 File" button to commit your changes to a new audio file.





2 SOLVE COMMON NOISE PROBLEMS

PROBLEM: WIND NOISE

It's not unusual to be left with annoying wind noise after recording something in the open air. However, chances are it can be blocked out. Import the audio into Reaper, click the track's FX channel, and then select ReaEQ. When you can hear only the wind, its energy is toward the left of the graph.

» We can remove the left-side low-pitched audio using a Low Shelf or High Pass filter (band one in Reaper). Select "High Pass," and drag node 1 down, and left and right (**Image C**). Moving node 1 to the right takes out more wind noise, but starts to remove some of the voice signal, especially with male voices. It's up to you to find the right balance.

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PROBLEM: RINGING

Audio is only as good as the room it is recorded in. If your room is too resonant, it can sound as if a wine glass is left ringing after every word has been spoken. To sort this out, you need to throw your audio into Reaper, click FX, and select ReaEQ. Drag node 3 as high as it can go, and reduce the Bandwidth to 0.10.

Drag the node or tweak its Frequency slider while playing the ringy audio. This will emphasize certain frequencies. Search for the ringing sound; when you find it, crank the Gain down to below 0. Adjust the Gain and Bandwidth to reduce the ring and leave the desired audio intact (**Image D**). You may need to use multiband nodes and additional ReaEQs.

PROBLEM: POWER-LINE HUM

Badly grounded equipment can introduce a 60Hz power-line hum in your signal. You can curtail it. Drag the audio into Reaper, click FX, and select ReaEQ. This will bring up a customizable EQ and an analysis of the audio while it's playing. Try to isolate a part of the signal with the hum to make this easier.

Pull down the numbered circles at the points where the hum is active. The blue dips should be placed to counteract the yellow bumps. You can change the "thickness" of the cuts with the Bandwidth control—this can prevent the desired audio from being degraded. It's unlikely you will entirely remove the hum, but you can reduce it

3 ADVANCED PROCESSING

PROBLEM: CLICKS

Sometimes a poorly edited audio file will have cuts that have been made at inappropriate times, resulting in clicks during audio playback. If your audio file has this problem, zoom in as close as possible to the clicking point, and there should be a moment when the audio wave moves almost vertically.

Whenever Reaper makes a region, it creates a microscopic fade in/out, reducing the volume at the edges. If we select the area around the vertical in Reaper and hit Ctrl + Del, it'll be chopped out and will fade nicely between the waves on either side (Image E). You'll need to zoom in and find every click.

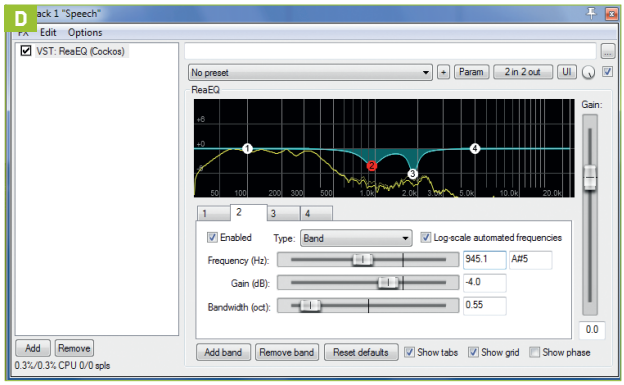
PROBLEM: BACKGROUND NOISE

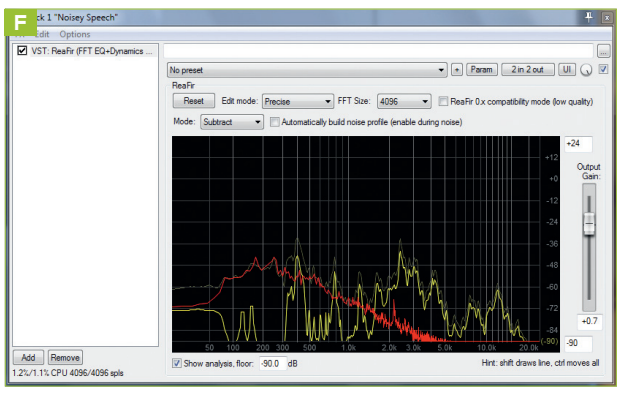
To reduce constant noise, import the audio into Reaper and click FX in the channel below (Image F). Choose "VST: ReaFir." Change the Mode to Subtract, and tick the "Automatically build noise profile" box. Play a part of your clip with only the noise audible—not any wanted parts—to build a profile. Untick the box, hit Play, and the noise should be reduced.

Another way to reduce background noise is with a gate. Add ReaGate instead of—or as well as—ReaFir. Increase the level of the ReaGate to a maximum and play the audio. Nothing should be audible. Move the ReaGate down again while playing the audio until you reach a setting where the wanted material is audible, but the noise isn't.

There are plenty of ways to reduce, or even remove, common audio problems. But in doing so, consider the effect that the cleanup is having on the desired audio—sometimes it can be better to keep some of the unwanted sound if removing it completely would degrade the material. Human speech, for example, can easily lose its natural feeling and expression when it is messed around with too much.

Keep in mind that certain things just aren't possible to get rid of completely when editing audio. Background sound can be lessened, but the results depend on the type of noise. Constant noise that stays similar in level and content is easier to take away, but sounds with a more random character—crowd noise, for instance—can't always be removed.





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Stream Games with Raptr

YOU'LL NEED THIS

AN AMD GRAPHICS CARD

This tutorial is for Raptr, which is only available for AMD graphics cards.

ONE OF THE BIGGEST TECH STORIES of the last several years has been the rise of streaming video games online. Between the meteoric growth of streaming site Twitch, the propagation of professional gamer personalities on YouTube, and the burgeoning eSports scene, game streaming has quickly become a very big deal.

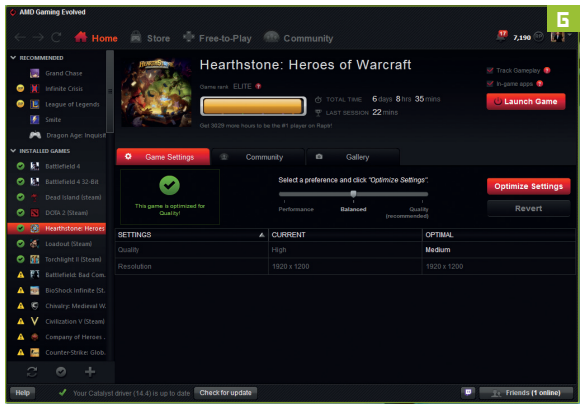
It certainly isn't small-fry anymore—something aptly demonstrated by the fact that PewDiePie is YouTube's biggest success in the last 12 months. In case you didn't know, PewDiePie's channel is all about gaming, and he makes a decent living from it.

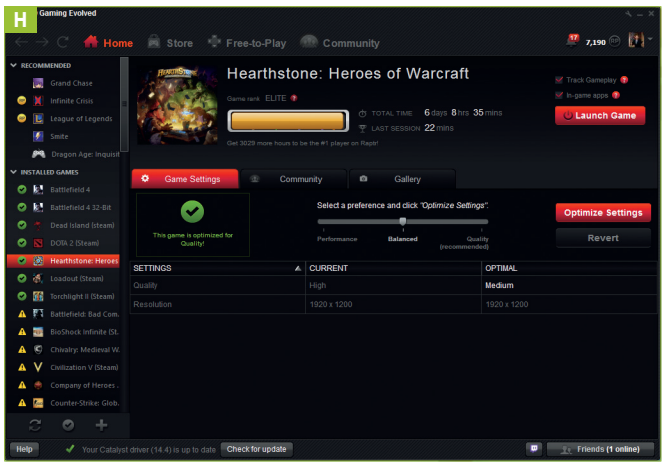
That's why now would be a great time to get it in on the streaming scene yourself, if you've got the time and inclination. Traditionally, it's been somewhat complicated, with programs like XSplit and OBS taking a good amount of fiddling to get up and running exactly as you want. Fortunately, if you have an AMD graphics card, there's another option now: use the version of Raptr that ships with AMD's graphics drivers. Here's how to get a piece of the streaming action.

1 CONFIGURE RAPTR

"Keep your graphics card drivers up to date" is a standard mantra for us, and should be for any gamer, but it always amazes us how many readers don't pay heed to this excellent advice. AMD has started packaging a version of Raptr with its drivers, and among other things, it highlights when there is a new driver release, so it's worth grabbing for that reason alone. Get the latest versions from www.amd.com.

One of the main reasons why AMD has bundled Raptr with its drivers is to give you a simple way to optimize your games so that they run smoothly and still look good (something that Nvidia offered first with its GeForce Experience). Streaming can be something of a resource hog, so start by optimizing the game you intend to play. Pick the performance preference for your game and then hit Optimize (**Image G**).





2 SET UP A TWITCH ACCOUNT

In order to stream your gaming prowess, you're going to need a Twitch account. Thankfully, it will cost you absolutely nothing to sign up for Twitch, so there's no reason not to. Head over to www.twitch.tv and hit "Sign up" in the top right-hand corner. You can sign in with your Facebook account if you want. Alternatively, pick a username and password, then enter your date of birth and your email address.

Twitch can automatically archive your broadcasts so that they can be watched later. Not only is this good for letting people view your streams at a more suitable time for them, it enables you to check that your stream is working as you intended. In order to turn archives on, you need to go into your settings screen, select "Channel & videos," then check the box titled "Archive Broadcasts" (**Image H**).

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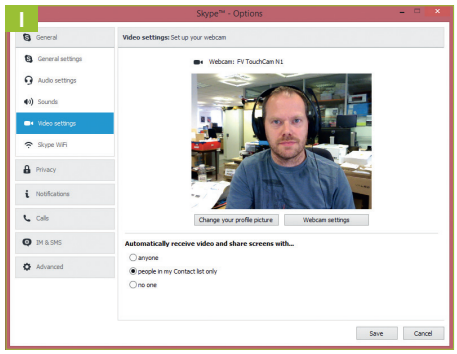


The basic interface for Raptr's Twitch streaming lets you define which corner of the screen your webcam video should appear in, but that's it. This is why you need to configure your webcam separately first—ideally, using the software that came with it, or failing that, a generic tool (such as Skype), to ensure that the white levels are correct and that you can, you know, see yourself properly (**Image I**).

Just as you have to get your webcam settings right before you start streaming, it's important to get your microphone to decent levels as well. Open the Control Panel and select Sound. Click on the Recording tab, highlight your microphone, and hit the Configure button. Run the "Set up microphone" wizard to get it up and running. If you want to double-check, use the test call in Skype.

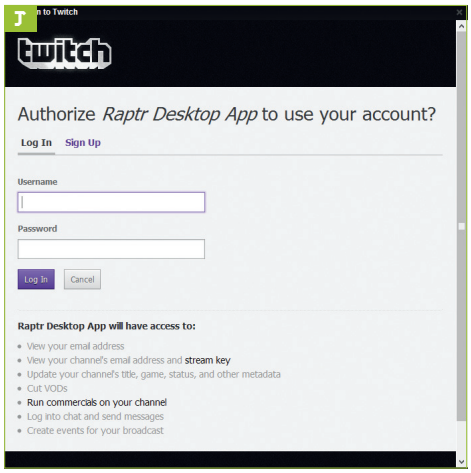
3 CONNECT YOUR TWITCH ACCOUNT

Open the main AMD Gaming Evolved Control Center screen and you'll notice a tiny Twitch icon in the bottom-right corner of the screen, to the left of the "Friends online" button. Click this icon to enter your Twitch login details—just click the "Log in to Twitch" button at the top of this window and enter the username and password you created in step 3 of this walkthrough (**Image J**).

Once you're signed in, you should click that little Twitch icon again. Here, you can configure the streaming quality of your game. The quality of your stream is defined by the power of your PC and the upload bandwidth of your Internet connection (**Image K**). Getting the quality settings right takes some trial and error, but we recommend trying the Medium quality setting and seeing what the output is like.

Click the Looks tab to overlay the Twitch chat over your stream. This is also where you'll find the webcam overlay options. Check the checkbox next to "Enable webcam" and set where your webcam image should go. Different locations work best for different games, but top-right is most common. The Audio tab is where you'll find options for balancing the game sound against your microphone levels (**Image L**).

You're now ready to start streaming. Launch the game of your choice and once it's up and running, press Ctrl + Tab to bring up the Gaming Evolved screen. You can hit the button to start streaming or use Page Up + B to start streaming, as well (**Image M**). Stream for a minute or so to make sure it's working, then watch the replay to make sure your sound levels are right and the quality settings are smooth.



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BUILD IT

ALAINA YEE **MANAGING EDITOR**

Build Your Own Super-Charged Set-Top Box

LENGTH OF TIME: **1–3 HOURS** | LEVEL OF DIFFICULTY: **EASY**

Yeah, it's cute—but this wee unit runs circles around your off-the-shelf set-top device. If you hate a cluttered home-theater setup, put Intel's Next Unit of Computing to work as a combo streaming unit, DVR, retro-gaming station, and more

A PC IN DISGUISE

FORGET CHROMECASTS and Rokus—sure, they're cheap and easy, but they also have decidedly annoying downsides, too. (First and foremost, the inability to use a proper physical keyboard and mouse to navigate around; second, stripped-down interfaces for services like YouTube and Netflix.) And why buy a TiVo and be stuck with both a subscription fee and a fixed amount of space? Let's not even get into the pitfalls of investing in something like the Ouya for emulated retro gaming.

We certainly can understand wanting convenience, but there's no need to trade in the ability to pick your parts (and later upgrade them) to do so—not when you could use an Intel NUC as an HTPC. If you're a fan of tiny footprints and want a rig that'll do the job of a Roku 3 plus a ton more, but with less involvement than our July 2014's Thin Mini-ITX build, we'll walk you through the build as well as show you how to put it to work. Bonus: it's simple enough that your more tech-savvy relatives can put one together on their own.

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1. **This NUC supports up to 16GB of RAM in dual-channel mode; slide in the SO-DIMMs here. We put 8GB in our unit, but could upgrade down the road if need be.**

2. **Insert the mSATA drive at an angle, then anchor it via a single Phillips screw. We picked an Intel 530 for this particular rig because it was handy, but any will work just fine.**

3. **The mSATA drive, like in the first-generation of NUCs, sits over the wireless card. Unlike the previous gen, you won't need to worry about it overheating, though.**

4. **This double-decker NUC has a separate tray for a 2.5-inch drive. We grabbed an old 750GB drive, but will likely upgrade to a 2TB one later on.**

NUC PARTS, ASSEMBLE

IF YOU'RE A SEASONED veteran of our more challenging Build Its, putting together this particular NUC will feel like child's play. The only things that need to be added are an mSATA SSD, a mechanical hard drive, and RAM—that's it. This second-generation NUC is a barebones kit that comes with a snappy Core i5-4250U dual-core CPU with Intel HD 5000 on-board graphics, and a pre-installed 802.11AC and Bluetooth 4.0 card.

First, open the case by unscrewing the bottom panel's four Phillips screws and then pulling it off. Set it aside, then gently pull up the 2.5-inch HDD tray and either flip it over or twist it off to the side to access the motherboard. We opted to install the RAM first—for this build, we grabbed two 4GB Crucial SO-DIMM sticks we had lying around. The NUC's motherboard can accommodate up to 16GB, but we don't think more than 8GB is necessary right now.

Insert each SO-DIMM at an angle, then push the RAM down until it's captured by each slot's arms. (To remove, just gently pull on both of the arms with your fingernails or use a pen.) Next, slide the mSATA SSD at an angle into its slot (it's positioned over the wireless card), then press it down and secure it with a single Phillips screw.

We selected a 180GB Intel 530 for our mSATA SSD, which is a little roomier than our usual minimal requirement of 128GB. However, we wanted a touch more storage space to use for games—partially because of the faster loading times, and partially because we'll be dedicating the 750GB mechanical hard drive solely to DVR storage. Slide the 2.5-inch drive into its bay, and secure it with two screws.

Replace the 2.5-inch HDD tray over the motherboard, taking care to seat it properly so the top of the 2.5-inch HDD lies flush with the lip of the chassis. Before putting the bottom panel back on, note the two circular notches on the side of it that'll face the HDD tray. The one that isn't a complete circle should be matched with the post that sits directly next to the mechanical hard drive, so that the panel lies flat when reattaching it.

One note for system boot—for whatever reason, our NUC's UEFI interface recognized the mechanical hard drive as the sole UEFI boot device, while the mSATA SSD and our external DVD drive appeared only under legacy BIOS boot devices. That made for some amusing moments when trying to boot to the DVD drive after our trial install of Windows 8. Our solution? We disabled UEFI boot devices altogether.

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SOFTWARE, ROLL OUT

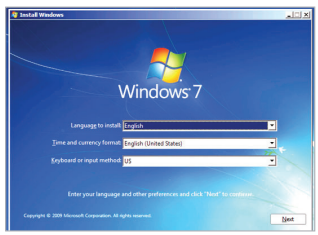
THE BUILD ITSELF IS the easy part—you'll spend more time downloading and configuring the software for this particular project. At some points, you may even feel a bit like Goldilocks when trying to choose which program is *just right*...

1 INSTALL WINDOWS 7

FOR THOSE WHO'VE come around to Windows 8 and enjoy its additional features such as updated driver stack and the ability to trim SSDs on command, opting for Windows 7 may seem like a step backward. Or clinging to an era that's set to fade soon. But since we want our NUC to function as a DVR, we need to install PVR software, and in Windows 7 that's as simple as firing up Windows Media Center.

Yes, there's certainly PVR software available for Windows 8, but your options become a lot less easy (or a lot less cheap). Trust us; we tried the Windows 8 route first. If you want to keep things speeding along, you'll have to fork over $100 for the "Pro Pack" that includes Windows Media Center if you're not running Win 8/8.1 Pro, and $10 for just Windows Media Center if you are. Otherwise, you may end up spending hours, as we did, grappling with free software like NextPVR (http://www.nextpvr.com) or MediaPortal (www.team-mediaportal.com). In the case of the former, it just flat-out refused to recognize our TV tuner despite our best efforts; in the case of the latter, its configuration settings are not designed to play nice with Windows 8.

This challenge may only encourage you, of course—but to keep in the theme of a fast, effortless build, we went the path of least resistance. Even if it did mean having to install nearly all the drivers for the NUC manually.



2 TV TUNER SETUP

WE'RE NOT TECHNICALLY done with hardware just yet—our next step is to set up an external TV tuner unit. Our choice? The Silicon Dust HDHomeRun Plus. We could have picked any external TV tuner, like the single-tuner Hauppauge WinTV-HVR 950Q if we wanted to save some cash, or either the Silicon Dust HDHomeRun Prime or Ceton InfiniTV4 if we had cable. But for our situation, the HDHomeRun Plus works out best, as we're just fine with OTA broadcasts, and we also like that having to put HDHomeRun Plus on our home network lets us watch TV on other systems and devices, too. And because we're going with the OTA route, we're pairing our HDHomeRun Plus with the highly favored Terk HDTVa Indoor Amplified HD antenna.

Install the drivers and/or included software for your TV tuner after you've connected it. For the HDHomeRun Plus, that involves downloading the latest software from Silicon Dust's forums, running the setup application to scan channels, and setting the main program it'll associate with.

3 CONFIGURE WINDOWS MEDIA CENTER

OPEN WINDOWS MEDIA CENTER. If it doesn't automatically recognize the attachment of a TV tuner and begin the process of scanning for channels, go to Tasks → Settings → TV → TV Signal → Set Up TV Signal to start it manually. Enter the relevant information about your location and TV tuner, then sit back and wait.

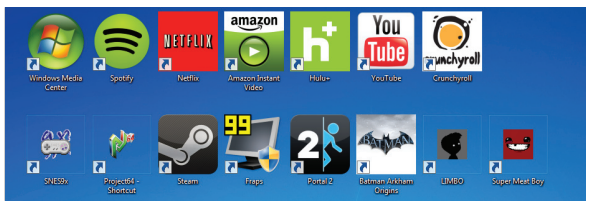
Afterward, go to Tasks → Settings → TV → Recorder and set up where you want to store recordings ("Recorder Storage"), from where to pull in any recordings that you might move elsewhere but still want to watch through Windows Media Center ("Media Libraries"), and your recording settings ("Recording Defaults").

Once you're set up, go to TV → Live TV to watch broadcasts in real time. Head to TV → Recorded TV in order to schedule recording sessions. With our 750GB hard drive, we chose to use 650GB of its available space for 75 hours of HD recording.

4 SET UP ACCESS TO STREAMING SERVICES

YOU CAN GO TWO WAYS on this. For a one-stop shop that includes the ability to access the music and videos you have locally (and even DVR functionality—though we had no luck getting the Windows Media Center plug-in to work), turn to XBMC (http://xbmc.org/download) and its many plug-ins. It doesn't come with a wide selection of add-ons, though; for some of the major popular services—like Netflix, Hulu, and Spotify— you'll have to find, download, and install those plug-ins yourself.

Alternatively, as a faster but less elegant option, you can just install the necessary programs and place shortcuts to websites on your desktop for your streaming services. This NUC is, after all, a full-fledged PC.



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5 DIVE INTO RETRO GAMING

WHILE LEGALITY OF ROMs lingers in a gray area, you can still download an emulator to play copyright-free games. (Or, if you're feeling bolder, copies of games you still own.) For those of us who still have a fondness for old-school consoles, scratching that nostalgia itch is as simple as grabbing SNES9x or Project64. You may have to try several different emulators for a given platform before you find the one that'll suit all your needs; we liked Project64 in particular for its smooth, upscaled rendering and customizable settings for the Xbox 360 controller we already had lying around.

However, if retro games aren't your thing, this NUC can handle a little modern gaming, too. Titles like *Limbo* and *Super Meat Boy* ran at just a frame or two under 60fps, while heftier games ran between a range of just a frame under 30fps (*Batman: Arkham Origins*, low settings), 40fps (*Portal 2*, medium settings), and 60fps (*Portal 2*, low settings). It's nothing that'll satisfy card-carrying members of hardcore PC gaming, but if you're trying to satisfy a console gamer, they should be fine.

MORE THAN MEETS THE EYE

USING THIS DIMINUTIVE BOX as a DVR, streaming unit, and light gaming box is just the tip of the iceberg, of course. If you want to use it for checking email and doing a bit of productivity-related work, this NUC will run circles around handheld devices. (Though when it comes to doing work on a HTPC, we doubt we'd do it often—but sometimes we just don't want to get off the couch.)

This build is also pretty flexible in terms of what you can put into it—and pair with it. If you're feeling particularly cheap, you can dial down the amount of RAM and the size of the 2.5-inch drive. Our recommendation, though, would be to go the opposite direction: For an ultra-quiet build, drop in a 1TB SSD as your second hard drive. At the very least, it can't hurt to have more storage space than less, even if you keep with mechanical hard drives. In terms of DVR equipment for OTA broadcasts, while we're happy with the Terk, we recommend first checking out www.antennaweb.org to confirm it's the right antenna for you. You may need a beefier external antenna to pick up all those gloriously free signals.

One thing we will reassure you on—if you've been following our NUC coverage since last year—is that these second-generation NUCs run nice and cool. No overheating issues, and the CPU fan only gets audible when under load (like, say, when you're running *Batman: Arkham Origins* on it). In fact, our 2.5-inch hard drive makes the most racket when viewing or recording media, though if you put this NUC in an enclosed entertainment system, noise shouldn't be an issue. These next-gen units also come with four USB 3.0 ports, a much appreciated improvement over the first-generation's USB 2.0 ports.

All in all, we're pretty satisfied with our tiny entertainment powerhouse. Sure, some folks may prefer the simplicity of a TiVo Roamio, which does both DVR recording (with double the number of tuners we have) and streaming for a handful of the most popular services. But at $200 for the device plus another $500 for lifetime service, we think it's a far superior option to have our own upgradable, far less chunky, and larger capacity HTPC that also lets us do some gaming. We can buy more TV tuners.

	Part	Price
Case	Intel NUC D54250WYKH	$360
CPU	Intel Core i5-4250U 1.3GHz	—
GPU	Intel HD 5000	—
SSD	Intel 530 180GB mSATA SSD	$140
HDD	2.5-inch Seagate 750GB	$64
RAM	8GB (2x4GB) Crucial DDR3 1600MHz SO-DIMM	$80
Networking	10/100/1000 Ethernet Port Wi-Fi 802.11AC, 802.11 a/b/g/n	—
Power Adapter	Mickey Mouse Power Adapter	$4
TV Tuner	Silicon Dust HDHomeRun Plus	$150
OTA Antenna	Terk HDTVa Indoor Amplified High-Definition Antenna	$40
Gaming Controller	Xbox 360 Controller (wired)	$30
OS	Windows 7 Home Premium 64-bit OEM	$100
PVR Software	Windows Media Center	—
Gaming Software	Emulated: SNES9x, Project64 Modern: Steam	—
Total		**$968**

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Elite Rigs Starting at $799

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REVIEWS

TESTED. REVIEWED. VERDICTIZED.

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MAINGEAR EPIC FORCE PAGE 76

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The Epic Force is fueled by red matter brought back through time by Ambassador Spock.

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Maingear Epic Force

Epic interior—and epic pricing

"EPIC" IS PLAYED OUT TODAY. From epic Dorito flavors to my epic video of the time I slipped on a banana peel and split my pants. In other words, *not* epic in any way understood, except perhaps some sexual innuendo–laden definition written by a drunk college kid on Urbandictionary.com.

Fortunately, that's not the case with Maingear's new Epic Force, which, well, truly is an epic build. First up, the hardware inside is fairly spectacular, although some might disagree with some of the choices (more on that later). In the graphics department, there's a pair of AMD Radeon R9 295 X2 cards in CrossFire mode. For the CPU, Intel's Core i7-4790K aka "Devil's Canyon" makes its fourth appearance in our magazine.

Devil's Canyon implies the system is built on Z97 instead of X79 (or X99, for that matter), but there's a feature to Z97 that Maingear takes advantage of. With its six native Intel SATA 6Gb/s ports, Maingear runs four 240GB Intel 730-series SSDs in RAID 0. This would be impossible with X79, which has but two native SATA 6Gb/s ports. The RAID setup gives a nice 1.45GB/s reads with 1.2GB/s writes.

The "epic" part in all this is the interior. There's about 900mm of radiators cooling the CPU, voltage regulator modules, and GPUs. In a move that makes a mockery of this year's Dream Machine, Maingear runs custom blocks and liquid cooling on the pair of Radeon R9 295 X2 cards. The plumbing for these components is the real joy, though. We've seen a lot of impeccable liquid-cooling jobs on a lot of exotic machines, but the Epic Force is now officially the most beautiful we've ever seen. The fancy plumbing is also functional—Maingear keeps the loops separated for the CPU and GPU. That way the liquid—or water or red matter—that's heated up by the GPUs doesn't heat up the CPU.

What about that all-important category of performance? There, the Epic doesn't break any records. No doubt it's fast, but it faces some stiff competition. First, the good news: Against our zero-point with its six-core Sandy Bridge-E CPU and GeForce GTX 690, it reminds us that it's time to replace our zero-point with something faster. Against last month's Dream Machine, it's an interesting battle. We compared it to the Devil's Canyon side of the double Dream Machine and it's dead even in application performance. In gaming though, DM's heavily overclocked Titan Z actually gave it the edge. Even worse, the quad-SLI GeForce 780 Ti–packing Origin PC Genesis easily outpaced both Dream Machine and the Epic Force in gaming. Again, it's not to say the Epic Force is slow—it's blistering fast—it's just that some other rigs are more, umm, blistery.

Still, let's not ignore the most impressive aspect here: the craftsmanship. The Epic Force exhibits an exquisite attention to detail that's one of the best, if not *the* best, we've ever seen. Is it worth the exorbitant price Maingear is asking? First, if you're asking what the price is, you're not the kind of person it's aimed at. And, frankly, knowing how much work and how hard it is to build a machine with an interior this impeccable, maybe it is. **–GORDON MAH UNG**

VERDICT 9

Maingear Epic Force

+ THE FORCE Truly stunning build quality and attention to detail.

– MIDI-CHLORIANS No, seriously, that's actually the price.

$11,783, www.maingear.com

BENCHMARKS

	ZERO-POINT	TESTED SYSTEM
Premiere Pro CS6 (sec)	2,000	2,035 (-2%)
Stitch.Efx 2.0 (sec)	831	665
ProShow Producer 5.0 (sec)	1,446	1,144
x264 HD 5.0 (fps)	21.1	20.9 (-1%)
Batman: Arkham City (fps)	76	187 (+146%)
3DMark 11	5,847	14,714 (+152%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our current desktop test bed consists of a hexa-core 3.2GHz Core i7-3930K 3.8GHz, 8GB of Corsair DDR3/1600, on an Asus Sabertooth X79 motherboard. We are running a GeForce GTX 690, an OCZ Vertex 3 SSD, and 64-bit Windows 7 Professional.

SPECIFICATIONS

Processor	Intel 4GHz Core i7-4790K overclocked to 4.8GHz
Mobo	Gigabyte Z97X-Gaming G1
RAM	16GB Corsair Dominator Platinum DDR3/2133
Graphics	AMD Radeon R9 295 X2
Storage	4x 240GB Intel 730 SSD, 3TB Seagate Barracuda XT
Optical Drive	LG WH16NS40 Blu-ray burner
Case/PSU	Custom-painted Corsair 900D / Corsair AX1500i

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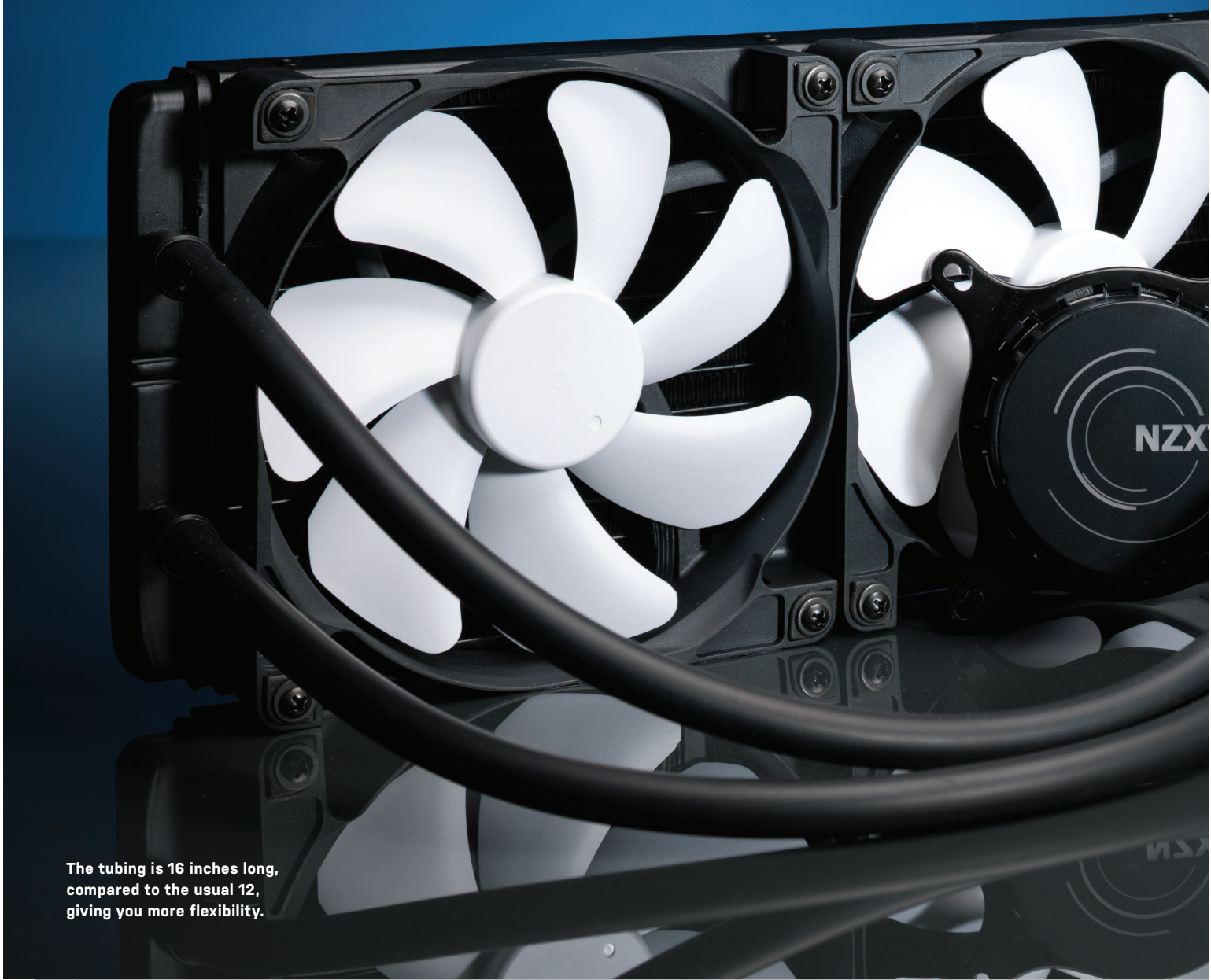
NZXT Kraken X61

Its priorities are in order

WHEN YOU THINK about it, a closed-loop liquid cooler (CLC) is an odd thing to put in a computer. Tubes full of water, pumping into a radiator? Sounds like something fit more for a car than a PC. Why not just put a standard air cooler in there? To be honest, an air cooler works perfectly fine for most setups. But if you're prepared to spend $100 or more on this component, and you want to squeeze another few megahertz out of your CPU, something like NZXT's Kraken X61 can fit the bill beautifully (provided that your case is large enough to accommodate one).

Generally, CLCs come in two radiator sizes: 120mm and 240mm. They use one or more 120mm fans. NZXT, however, usually makes 140mm and 280mm models (though they just announced the X31, a 120mm unit, as this issue went to press). The Kraken X61 is the latter. At first glance, it doesn't seem much different from their X60. Since that was one of our most favorite CLCs, though, it's not a bad place to start. NZXT makes a



The tubing is 16 inches long, compared to the usual 12, giving you more flexibility.

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number of improvements with the sequel.

One is overall noise. We were already impressed with the X60 (and the 140mm X40, for that matter), but the X61 takes it to a level that we didn't think possible. Even on its "Performance" setting, with the fans spinning at about 1,400rpm and the pump jamming away at 3,200rpm, all we could hear was the gentle thrum of air passing through its fan blades. You can manually crank the fans up to their max of 2,000rpm and it gets pretty loud, but we only saw a difference of a couple degrees Celsius under load. The fans also have integrated rubber pads now, to reduce vibration.

Physical installation hasn't changed much from the X60. The backplate is still plastic, but it's more rugged than before. You place it underneath the motherboard and screw in a set of four mounting screws. It doesn't take more than a minute. A set of four nuts secures the heatsink/pump combo onto the screws, and you can use a standard Phillips screwdriver to tighten the nuts. The fans plug directly into a cable attached to the pump, and there's a SATA power connector to hook up, and the pump itself has a three-pin cable that connects to the motherboard's CPU fan header. That last part happens because the pump is PWM-controlled, so it adjusts its speed according to the temperature of the CPU. All the cabling uses high-quality black braided sleeving. And NZXT backs all this gear with a six-year warranty.

NZXT's CAM software is definitely a visual upgrade from its earlier offerings. Lots of big, bold numbers. And it's expanded from CPU cooler control to also monitor things like hard drive space, GPU temperature, and Internet bandwidth consumption. You can also log into a cloud service and monitor your cooler from another computer. The company was working on iOS and Android monitoring apps as this issue went to press, which should be available by the time you read this.

If there is a flaw here, it's that the X61 could be too quiet for its own good. By default, "Silent" mode will set the fans to a mere 500rpm, even under load. So you get a relatively high load temp of 75 C, though it really is silent at that fan speed. We could double that to 1,000rpm without detecting much turbulence, and our cooling results fell more in line with the competition; tweaking speeds and tracking that effect in the CAM software is pretty easy.

–TOM MCNAMARA

VERDICT 9 KICK ASS!

NZXT Kraken X61

+ ZEPHYR, GREEK WIND GOD Excellent performance; super quiet; smooth installation.

– MERCURY ZEPHYR Fan speeds require some manual tweaking for optimal temps.

$140, www.nzxt.com

SPECIFICATIONS

Radiator Dimensions (H x D x W)	1.2 x 12.2 x 5.5 inches
Weight	2.8 lbs
Stock Fans	2x 14cm PWM
Socket Support	LGA 775/1150/1155/1156/1366/2011; AM2/AM2+/AM3/AM3+/FM1/FM2/FM2+
Additional Fan Support	2x 14cm

BENCHMARKS

	NZXT Kraken X61 Quiet / Performance Mode	NZXT Kraken X60 Quiet / Performance Mode	Cooler Master Nepton 280L Quiet / Performance Mode	Corsair H100i Quiet / Performance Mode
Ambient Air	23.3 / 22.7	20.7 / 20.9	22.1 / 22.4	20.3 / 20.5
Idle Temperature	34 / 32.6	29.7 / 28.8	33.2 / 30	30.7 / 29.3
Load Temperature	75 / 65.3	66 / 61.8	64.5 / 63.3	67.1 / 61
Load - Ambient	51.7 / 42.6	45.3 / 40.9	**42.4** / 40.9	46.8 / **40.5**
Street Price	$140	discontinued	$120	$100

Best scores are bolded. All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.1GHz, on an Asus Rampage IV Extreme motherboard in a Corsair 900D with stock fans set to Standard.

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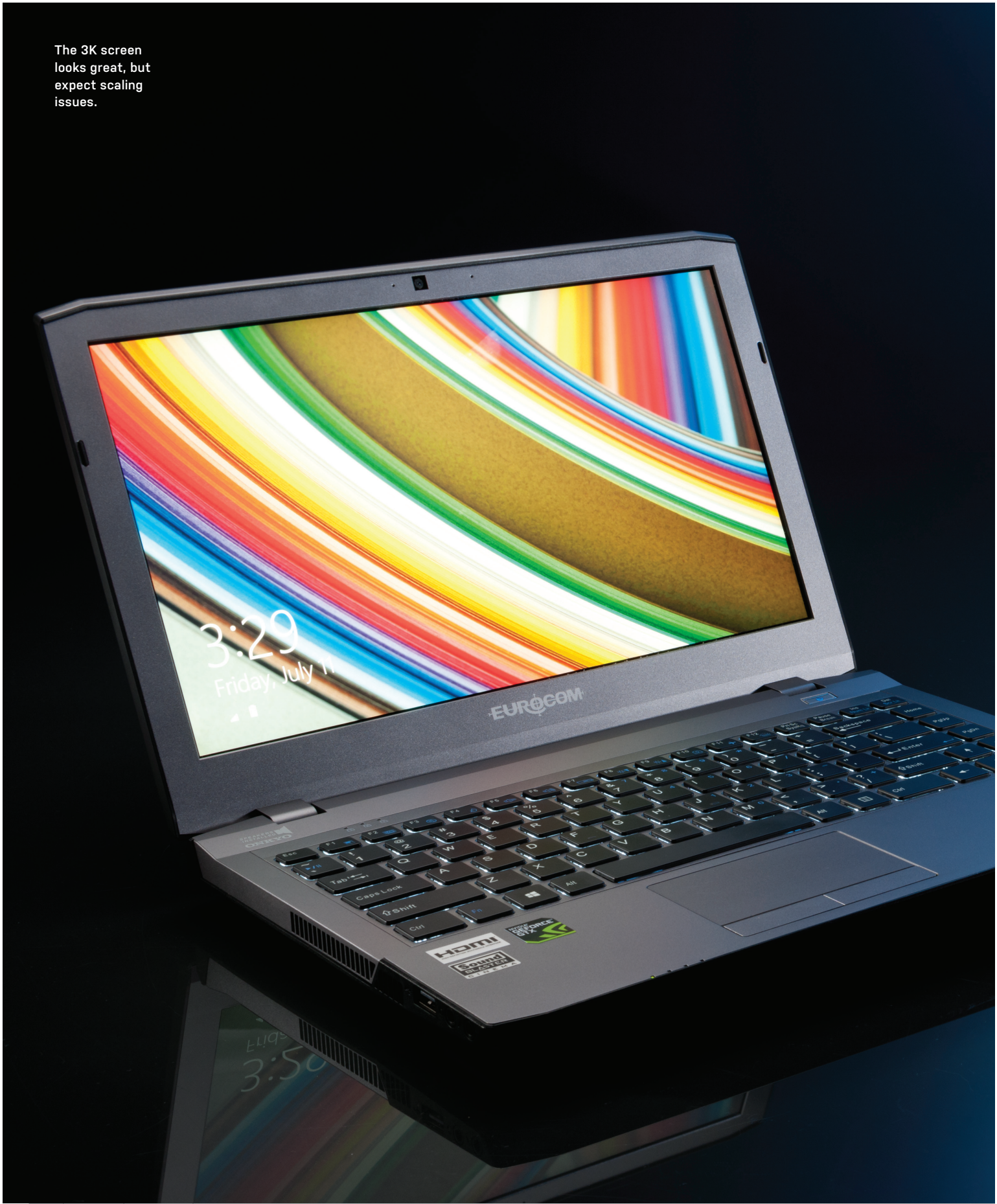

The 3K screen looks great, but expect scaling issues.

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Eurocom M4

Turns out 3K is just OK

WHILE 4K MAY be all the rage these days, we've yet to see that resolution grace the screens of our gaming laptop panels. The next best thing, however, may be here. Eurocom's M4 gaming notebook made its way into our Lab sporting a super sharp 13.3-inch 3200x1800-resolution display. Dubbed 3K, it has a pixel density of 276 pixels per inch (PPI). This makes it poopoo all over Apple's much-touted MacBook Pro Retina display. What, 227 PPI? Is this 2013 or something?

In general, the screen is excellent and the little Ultra HD (UHD) video content out there on the web looks great. Its beauty is aided by the fact that it's running on an IPS panel, so colors look vibrant and accurate. The visual experience isn't perfect, however. Because its resolution is so high, many programs are not optimized for it and end up looking super tiny. Furthermore, both Chrome and Steam look incredibly soft on the M4. When we fired up Steam's Big Picture Mode, the screen started glitching out and became unusable. It's clear that many of these programs aren't optimized for UHD displays and it's a shame that there isn't more super high resolution video content out there. Perhaps these issues will be resolved someday, but they're real gripes today.

In addition to the scaling issues, another quandary for ultra-sharp monitors is that they need really high-end GPUs; that is, if you plan to game on them. Powering our Eurocom M4 is Nvidia's GeForce GTX 860M. The card actually runs on the company's new Maxwell architecture and features a 1,029MHz GPU clock, 2,500MHz memory clock, and has 2GB of GDDR5 VRAM. It's in the mid-tier of mobile GPUs by today's standard, but manages to blow away our zero-point's older midrange 765M by roughly 30–70 percent in our graphics benchmarks, which is really impressive. For 1080p gaming, it's great. In *BioShock Infinite*, we garnered average framerates in the mid-70s on the game's default medium settings. At 3K, however, it got ugly. The M4 could only muster average framerates in the mid-20s. We fired up *Left 4 Dead* 2 to see how the notebook would handle a non-taxing game and we actually got low-40s average framerates playing the game maxed out. While this is technically playable, we'd probably opt to lower the res for a smoother experience. In general, we'd crank this down to 1080p resolution for the majority of today's games so that you can run them with more bells and whistles turned up while getting a smoother framerate.

While the GPU may not be the highest-end card out there, our overall configuration still rang in at $2,319, which is by no means cheap. That said, it did come with good components. Inside the relatively small 13.2x9.9x1.28-inch chassis is an Intel quad-core 3GHz Core i7-4930MX, which can turbo up to 3.9GHz, and 16GB of DDR3/1866 RAM. At $1,096, the CPU itself accounts for almost half the price of the notebook. In our CPU tests, the M4 performed between 5 percent to 9 percent better than our zero-point's Core i7-4700MQ. In terms of storage, our unit came with a 120GB Micron M500 mSATA SSD, and for mass storage, a 1TB 7,200rpm HDD. In the battery department, the M4 comes with a 6-cell lithium ion, which lasted over 3.5 hours in our video rundown test. Rounding out the chassis, we have a competent backlit keyboard and trackpad with two dedicated buttons.

In general, the M4 has a lot going for it, but it does have its fair share of issues. While the laptop never got hot, it did get plenty loud when we were gaming. In addition, the speakers are weak, and it didn't help that the headphone jack would randomly not work at times. The M4's biggest issue, however, is its price. Spending over $2K for halfway-optimized 3K may not be worth it for many. **–JIMMY THANG**

VERDICT 8

Eurocom M4

+ M4 Super-sharp resolution; beautiful screen; good overall performance; relatively light and portable.

– DERRINGER Scaling issues; loud; chassis looks generic; not cheap.

$2,319, www.eurocom.com

BENCHMARKS

	ZERO-POINT	
Stitch.Efx 2.0 (sec)	962	898
Proshow Producer 5 (sec)	1,629	1,490
x264 HD 5.0	13.5	14.2
Bioshock Infinite (fps)	36.1	55.64
Metro Last Light (fps)	30.4	51.3
3DMark 11 Perf	4,170	5,341
Battery Life (min)	234	222 (-5.1%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero point notebook is an Alienware 14 with a 2.4GHz Intel Core i7-4700MQ, 16GB DDR3/1600, 256GB mSATA SSD, 750GB 5,400rpm HDD, a GeForce GTX 765M, and Windows 7 Home Premium 64-bit. *BioShock Infinite* tested at 1920x1080 at Ultra DX11 settings; *Metro Last Light* tested at 1920x1080 at DX11 medium quality settings with PhysX disabled.

SPECIFICATIONS

CPU	3GHz Intel Core i7-4930MX
RAM	16GB DDR3/1866
Chipset	Intel HM87
GPU	Nvidia GeForce GTX 860M
Display	13.3-inch, 3200x1800 IPS panel
Storage	1TB (7,200rpm) HDD, 120GB mSATA SSD
Connectivity	Ethernet, HDMI, VGA, media card reader, 1x USB 2.0, 3x USB 3.0, mic input, headphone input, 2MP webcam, Bluetooth 4.0, 802.11AC
Weight Lap / Carry	4 lbs, 9.2 oz/ 5 lbs, 12.7 oz

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Aspire Switch 10

Not quite ready to steal the crown

IF AMAZON'S LIST of best-selling laptops is any indication, there's a quite a market for Windows 8.1 convertible laptops—and as of late, the lion's share of buyers has been sinking their money into Asus's Transformer Book T100. Acer seems eager to take on the people's choice with its Aspire Switch 10, a similarly spec'd 10.1-inch convertible with two key design differences.

When it comes down to internals, the Switch 10 essentially contains the same guts as the T100. Its 1.33GHz Atom Z3745 CPU is just a slightly newer version of the T100's Z3740 that features a few small adjustments to the onboard graphics specs, and the benchmarks reflect the narrow gap in performance. In our 3DMark Ice Storm, Stitch, and ProShow 5 tests, the Switch 10 edged out the T100 by slim margins—for Stitch and ProShow, it bested the T100 by just a minute or two.

Where the Switch 10 sets itself apart is through its magnetic connector between the keyboard and tablet sections, as well as its trackpad. The former is a handy feature, and one we much prefer over having to press a button in order to pull away the tablet for independent use. Even clumsy folks (like some of us on staff) will find it easy to separate and reattach the Switch 10's parts without having to place the laptop on a table for stability—something we had to do with the T100.

The trackpad is also notable, but for more mixed reasons. Among its positive traits are its responsive, firm buttons and its generous size, but the downside to the latter is accidental mousing when typing on the diminutive keyboard. If you've got large hands, you'll be in for a lot of frustration if you don't adjust the angle of your hands while typing, as there's no palm rejection option available.

If that were our only main quibble with the Switch 10, we'd likely still pick it over the T100 (which we gave a 7, too), as it has a brighter screen, better battery life, and runs just as smoothly for basic productivity and the kind of light media consumption these lower-end laptops are meant for. Its handful of ports—HDMI, microSD, headset/mic jack, micro USB, and full USB—let us do day-to-day tasks like transfer photos from a camera, chat over Google Hangouts, and watch Netflix on a much bigger second screen; YouTube videos and ripped Blu-ray files ran without a hitch while Spotify, Word, Excel, and Firefox with a handful of tabs were loaded in the background. We also got an hour more of battery life in our rundown test than on the Asus. And while the Switch 10 feels a bit too dense to just throw into a bag and carry everywhere with you at all times, it's still lightweight enough to take on an extended trip and get some work done—a sort of netbook successor that offers what netbooks should have in the first place. It, like the T100, even comes with a complimentary copy of Office 2013.

Unfortunately, the Switch 10's keyboard makes it suitable only for the most emphatic typers (or those willing to, for whatever reason, bring a separate Bluetooth keyboard along with them). Light typers will find themselves swearing constantly under their breath when a key doesn't register. This, in addition to a lack of USB 3.0 ports, make it hard to see this particular convertible unseating the current king just yet. But it should win the hearts of some of the populace.

VERDICT 7

Aspire Switch 10

+ SCOOTER Bright IPS screen; magnetic connector; good battery life.

– SEGWAY No palm rejection for the trackpad; incredibly stiff keyboard.

$430, www.acer.com

SPECIFICATIONS

CPU	1.33GHz Intel Atom (Bay Trail) Z3745
RAM	2GB DDR3/1600
GPU	Intel HD Graphics
Display	10.1-inch, 1366x768 IPS touch display
Storage	64GB eMMC
Connectivity	Micro HDMI, m icroSD card reader, micro USB 2.0, USB 2.0, headphone/speaker combo input, 2MP front webcam, Bluetooth 4.0, 802.11 a/b/g/n
Weight Lap / Carry	2 lbs, 6.8 oz / 2 lbs, 10.2 oz

BENCHMARKS

	ZERO-POINT	
Battery Life	192	1,236
Stitch.Efx 2.0 (sec)	73	71
ProShow Producer 5.0 (sec)	118	117
3Dmark Ice Storm	15,264	17,478
3DMark Cloud Gate	1,236	1,330

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero point notebook is an Asus Transformer Book T100 with an Atom Z3740, 2GB DDR3, 64GB flash storage, and Windows 8.1.

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The brushed-aluminum finish on the back of the Switch 10's tablet looks very nice up close.

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A Crazy USB Collection

Three unique USB utensils land in the lab

The SanDisk Extreme Pro lives up to its name with its 128GB capacity and blazing speed.

A DINKY AND SLOW USB 2.0 key is last year's news. Today's USB drives are faster than ever, have capacity that was a fantasy just a year ago, and are surprisingly affordable. This month, we're testing three sweet drives that redefine the concept of USB storage, including a blazing-fast USB key from SanDisk, a gigantic 4TB handheld drive from Seagate, and an SSD wrapped in a USB enclosure from LaCie. One of them should definitely be in your PC blowout kit. **–JOSH NOREM**

SANDISK EXTREME PRO USB 3.0

THE SANDISK EXTREME PRO has a lot of hyperbole in its name, but one glance at its specs and you can see it's a fitting title. First, at 128GB it's the largest-capacity USB key we've ever tested. Second, the drive's specs claim it performs more than twice as fast as USB 3.0 keys we've tested in the past, which typically top out at around 110MB/s for read and write speeds. This bad mother is rated at 260MB/s read speeds, and 240MB/s write speeds, which is ludicrous for a USB key. Third, to show how serious SanDisk is with this model, it's only available in the 128GB capacity, because how extreme can a 64GB key really be—know what we're saying?

On the software front, the drive comes with a data-encryption tool named SecureAccess, which is an executable that creates a 128-bit AES encrypted volume. You keep the executable on the key (or anywhere, really), type in your password, and the volume opens. When you close the window, the data is safe; if you forget your password, you'll have to wipe the drive, as there's no recovery.

In addition to these righteous features, this key has the perfect body style in our opinion: it has no cap, a tough aluminum shell, a sturdy loop for your keychain, and a rocker switch to deploy the key. We love it, and wouldn't mind if all future USB keys were built like this.

In testing, the Sandisk came close to hitting its peak speeds in our real-world file copy tests, and definitely hit them in synthetic benchmarks. The key choked a bit on some of the larger video files we had in our test folder, but averaged around 175MB/s or so during the 14GB transfer. That's blazing fast, and the fastest USB key we've ever tested.

In the end, this key's killer speed, huge capacity, perfect chassis, and handy encryption software make it the total package. We honestly can't think of a single thing to criticize.

VERDICT 10 KICK ASS!

SanDisk Extreme Pro USB 3.0

$160, www.sandisk.com

BENCHMARKS

	SanDisk Extreme 128GB	Seagate Backup Plus Fast	LaCie Slim	WD Passport Slim 1TB (for comparison)
Price	$160	$270	$150	$80
Warranty	Lifetime	3 years	2 years	3 years
CrystalDiskMark read (MB/s)	264.2	244	424.9	101.4
CrystalDiskMark write (MB/s)	245.7	241	373.6	99.9
14GB write (sec)	86	76	75	275

Our test system is a Core i7-3770K on an Asus P8Z77-V Deluxe, 16GB of DDR3/1600, 64-bit Windows 8.1 and an Intel 730-series SSD. USB 3.0 testing was performed using the motherboard's USB 3.0 controller.

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SEAGATE BACKUP PLUS FAST 4TB

SEAGATE'S BACKUP PLUS FAST drive is portable storage for power users, plain and simple. It's the highest capacity portable hard drive in captivity, and Seagate achieves this feat by striping together two 9.5mm Samsung M9T 2TB hard drives into a RAID 0 array. As soon as you plug it in, the OS sees the drive as a 3.63TB formatted volume, so you don't have to do any setup. Unfortunately, you can't modify it to be a RAID 1 array. The drive is a bus-powered USB 3.0 model, so it doesn't need auxiliary power of any kind, and it even includes two USB cables; one for modern systems that can provide enough power though a single port, and a Y-shaped cable for those with older PCs that require two connections to pump enough juice into the drive.

Since it's designed to be used as a backup drive, it includes a tool called Seagate Dashboard. This software acts as a hub for several backup tasks including backing up data on a PC, the data on your smartphone (iOS and Android only), and saving your social media data on Facebook, Flickr, and Youtube. You can also restore your backups to their original location, as well.

PC backups can be simple (videos, music, etc.) or you can select individual files and folders. You can then have it back up continuously or on a schedule. It's slick, easy-to-use, and works like a charm. You can even create system "snapshots" instead of individual files and folders, which we appreciated.

In testing, the RAID 0 configuration showed why it used to be the go-to setup for power users, as this is one fast drive. It was able to sustain around 200MB/s in our file copy test, which is faster than the speediest desktop hard-disk drives available. It also didn't choke on any of the files we offered it, unlike its solid-state brethren in this roundup.

Overall, this is one sweet drive. We don't like how thick it is, but that comes with the two-drive territory. It's fast though, holds a ton of data, and includes slick backup software, too. If you need more storage than an SSD drive allows, this is the one to buy.

VERDICT 9 KICK ASS!

Seagate Backup Plus Fast 4TB

$270, www.seagate.com

This bad mutha sports dual 2TB drives in RAID 0.

LACIE PORSCHE DESIGN SLIM DRIVE USB 3.0

LACIE HAS NEVER BEEN afraid to make a slick-looking drive that packs a punch, and that's what it's trying to do with its Slim drive with "Porsche Design." If you bought a laptop for maximum portability, this drive furthers that goal by its very slim 0.4-inch thickness, and weighing in at slightly less than a half-pound.

LaCie offers the drive in both a 500GB rotating-platter version and the 120GB SSD version you see here, which costs $65 more than the platter drive. Both come with a two-year warranty, which is kind of low but common for "cost sensitive" storage devices. However, LaCie has never been a company to skimp on anything, so we're surprised the warranty isn't at least three years.

Inside the matte aluminum shell is an SSD of unknown origin, and there's no easy way to open the shell without destroying the enclosure. There are rubber bumpers on both sides but it's otherwise a solid, brick-like case. On the side is a USB 3.0 connector with an extra-long cable; it's a shame LaCie couldn't find a way to integrate it with the shell since it's hard to store it with the cable poking out from the side.

The drive comes with two primary utilities—Genie Timeline for backup duties and a LaCie-branded version of TrueCrypt that lets you dedicate a portion of the drive's 117GB formatted capacity to be an encrypted volume. We love TrueCrypt, and are always glad to see it included as a utility on removable storage, so kudos to LaCie. The Genie Timeline software is also excellent and easy to use.

The Slim drive is certainly svelte, but a bit pricey.

In our benchmarks, the LaCie Slim racked up mildly impressive read and write scores, but it averaged around 200MB/s in our real-world file copy test, which put it dead-even with the platter-based RAID 0 setup of the Seagate. This means that in the real world, this bad boy is faster than a platter-based drive, but not a RAID 0 config.

All in all, the LaCie is a decent drive but there's nothing about it that really stands out or makes our hearts go pitter-patter. It's fast and has a good software package, but it's expensive and has smallish capacity. If you absolutely need a super-slim portable drive, it's a safe bet. Otherwise, go the DIY route and save yourself some cash.

VERDICT 8

LaCie Porsche Design Slim Drive USB 3.0

$150, www.lacie.com

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You can also buy the Minix Neo M1 gyroscope remote to use instead of a standard mouse.

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Minix Neo X8-H

Lots of promise, not as much fulfillment

EVERY NOW AND THEN, a product comes along that gives a glimmer of what could be. In the case of the Minix Neo X8-H, that's the future of using Android mini-PCs as streaming set-top boxes. While the Roku 3 and Apple TV each certainly fulfill their audiences' needs, folks who crave better input controls and customizability may eventually find that they'll get their wish without having to shell out serious cash for a DIY HTPC build.

We had no better demonstration of this than when we first encountered the Neo X8-H's bundled remote. It has mushy buttons and must be pointed directly at the X8-H for input to register. So instead, we paired our Android Bluetooth keyboard and a Bluetooth mouse to the unit to dramatically increase our speed and accuracy in navigating screens. (You can also plug a standard Windows USB keyboard and USB mouse into the unit via its USB 2.0 ports, but without access to a dedicated "Home" button, it's not quite as good.)

Free access to the Google Play store also meant we could customize the content available on our Neo X8-H. We immediately downloaded Amazon Music with Prime Music, and then took advantage of our keyboard/mouse setup to create a few new playlists; having a scroll wheel made it easy to skim through long song lists designed for a touch interface. Gaining access to videos stored elsewhere on our network through XBMC was also a snap.

Besides flexibility, being built on Android OS offers much wider breadth than today's top-dog set-top boxes: The Neo X8-H's range of abilities encompasses editing documents, spreadsheets, and presentations via QuickOffice (which comes pre-installed), as well as functioning as a portable hotspot. If you ever want to travel with this Minix, it could be handy for more reasons than just killing time via TV episodes or music.

But despite these features, extra goodies like 4K support, and its outer good looks—a satiny, lightly rubberized black finish and rounded edges that balance out its surprisingly large external antenna—the Neo X8-H doesn't quite deliver as polished an experience as its competitors. Part of this isn't wholly the unit's fault: Due to the Android app landscape, some apps only have phone-screen–optimized interfaces (which look a bit silly on a TV), and Amazon has yet to release an app for Amazon Instant Video. Without Silverlight or Flash support in Android OS, you won't be able to access that catalog of movies and TV shows.

But the majority of the issue revolves around the Neo X8-H's own interface and selection of pre-installed software. Turn it on for the first time, and you'll have to go through the process of digging into settings and adding a Google account all on your own; there's no initial setup wizard to run you through it. Its main screen is a very basic, borderline-unattractive 10-foot UI that forces you to either organize shortcuts to Android apps in pre-set folders like "Video" and "Music," or litter the bottom edge with icons. And barely any apps come pre-installed; of the few notable ones included (like aforementioned XBMC and QuickOffice), Netflix was the lone representative of the streaming-media services we expected to see.

Added to this clunkiness is just-passable performance. Despite posting higher numbers in our benchmark tests, streaming video over Netflix was heavily compressed (even when running it over a fat pipe) and emulated games played through the RetroArch app stuttered. In comparison, our first-generation Nexus 7 had smooth playback in both scenarios. Essentially, you'll still be able to catch up on *Orange is the New Black* just fine, but it won't look as nice—and using the Neo X8-H as a gaming device is currently unattractive. (Particularly since it's yet to be updated with a driver to support an Xbox 360 controller, something the Nexus 7 natively supports.)

At $50 more than its nearest competitors, the Neo X8-H isn't positioned to win over a majority of households just yet—after all, extra options can balance out a lack of attractiveness, but not so an inability to match other set-top boxes in performance and user experience. Still, it's a nice example of what features we should be demanding as standard. **–ALAINA YEE**

VERDICT 6

Minix Neo X8-H

+ PEA SPROUTS: Android OS opens up a wider array of features and services available.

– BRUSSEL SPROUTS: Basic, somewhat clunky interface; minimal selection of pre-installed apps; only passable performance for streaming video; no real gaming support yet.

$150, www.polywell.com

SPECIFICATIONS

CPU	Quad-core Cortex A9r4
RAM	2GB DDR3
GPU	Octo Core Mali-450
Storage	16GB eMMC (expandable up to 48GB total via SD card slot)
Connectivity	10/100 Ethernet, SD/MMC card reader, 3x USB 2.0, OTG port, Microphone jack, Headphone jack, IR receiver, optical SPDIF, HDMI
Dimensions (H x W x D)	0.75 x 5 x 5 inches

BENCHMARKS

	ZERO-POINT	
PassMark PerformanceTest Mobile	1,264	3,271 (+159%)
3DMark Ice Storm	3,497	7,015 (+101%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our zero-point Android device is a first-generation Nexus 7 running a Cortex-A9 Tegra 3 1.2GHz quad-core chip, 1GB DDR3 RAM, 416MHz twelve-core Nvidia GeForce ULP, and 16GB of storage.

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Zalman Reserator 3 Max Dual

Size isn't everything

AMONG PC BUILDERS, Zalman is practically legendary. The company was the pioneer in the design of beautiful copper air coolers that offered both low temperatures and low noise. In recent years, though, the market has shifted from its "radial" or cylindrical design to blocky stacks of fins and even closed-loop liquid coolers (CLCs). The company has been selling conventional CLCs for several years now, but it obviously decided to do something really distinctive with the Reserator 3 Max Dual.

What you see in the photo functions similarly to a Corsair H100i or an NZXT Kraken X61. A pump pushes water through a set of tubes, which plugs into a radiator that has fans attached to it to expel heat out of the case. But while the pipes in a conventional PC liquid radiator flow through thin fins, the pipes in the Dual Max take a windy circuit right through the center. Zalman also carries over its radial fin design, instead of using the squared-off rows that we're used to seeing. The visual impact of this deviation from the norm is immediate and impressive.

These two sets of radial fins are spaced a little farther apart than a standard 240mm radiator, so you may need to install the bundled set of brackets to make your screw holes line up correctly—we did on our Corsair 900D case. The process is a bit fiddly and uses a number of tiny widgets, but the manual does a solid job of explaining how everything fits together. It didn't say which set of screws we were supposed to use, but after a little deductive reasoning, we used the loose ones in the bottom of the bag. The radial fins also stack pretty high; once you include the integrated fans in the measurement of the unit, you're looking at a height of 73mm, or about 2.9 inches. This is nearly the size of a standard radiator with fans installed on both sides, so there are a number of cases in which this unit simply won't fit.

After finishing installation, we noticed that the pump was noisier than average, even on a low setting, but it wasn't distracting when the case's side panel was on. The fans were quieter than normal, considering how much air they were moving—up to 2,000rpm. There's a 500rpm gap between the two highest speeds in the fan profile, though, so you'll hear a lot of engine-like revving if your temperature readings are floating on a threshold between the two speed settings. We had to select our speeds manually to avoid this revving. This cooler doesn't come with software to do that, so you'll have to control that in your motherboard's BIOS, or in the Windows-based fan control software that may come with your board.

Unfortunately, even the most aggressive cooling scenario couldn't keep up with the current top coolers. Under load, the performance of the Reserator 3 Dual Max was better than a tower-style air cooler, but not enough to justify the premium. With a street price of $140, you need to make a splash, but this CLC doesn't cause much of a ripple. The H100i currently goes for $100 and is still one of the best CLCs on the market, and a Cooler Master Hyper 212 Evo performs within spitting distance of the Dual Max and comes in around $35. While the Dual Max does perform better than air, it's difficult to recommend it over its competitors. **–TOM MCNAMARA**

VERDICT **5**

Zalman Reserator 3 Max Dual

+ 1776 Better cooling than air.

– 1775 Underwhelming performance; fiddly installation; bulky; pricey.

$140, www.zalman.com

SPECIFICATIONS

Radiator Dimensions (H x D x W)	2.9 x 10.8 x 4.8 inches
Weight	3.14 lbs
Stock Fans	2x 12cm PWM
Socket Support	LGA 775/1150/1155/1156/1366 /2011; AM2/AM2+/AM3/AM3+/FM1/FM2
Additional Fan Support	none

BENCHMARKS

	Zalman Reserator 3 Max Dual Quiet / Performance Mode	Cooler Master 212 EVO Quiet / Performance Mode	Corsair H100i Quiet / Performance Mode	Cooler Master Nepton 280L Quiet / Performance Mode
Ambient Air	23.6 / 23.6	20.5 / 20.3	20.3 / 20.5	22.1 / 22.4
Idle Temperature	34.5 / 32.8	35.5 / 30.5	30.7 / 29.3	33.2 / 30
Load Temperature	75.8 / 68.5	70 / 67.3	67.1 / 61	64.5 / 63.3
Load - Ambient	52.2 / 44.9	49.5 / 47	46.8 / **40.5**	**42.4** / 40.9
Street Price	$140	$35	$100	$120

Best overall scores are bolded. All temperatures in degrees Celsius. All tests performed with an Intel Core i7-3960X at 4.1GHz, on an Asus Rampage IV Extreme motherboard in a Corsair 900D with stock fans set to Standard.

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You could technically put on another set of fans, but few cases could accommodate that.

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Our fearless warrior ponders whether to open a chest with a lockpick or bash it to pieces.

Divinity: Original Sin

A flawed, but challenging RPG romp

IF YOU'RE LOOKING FOR A modern-day recreation of the *Baldur's Gate* series—or, really, any of those isometric Infinity Engine games of yesteryear—then *Divinity: Original Sin* might appear as if it has the potential to satisfy your old-school gaming urges, at first glance.

In many ways, it does. It's a delightfully deep roleplaying game that puts you in "control" of two characters at once. That's really a bit of a gimmick; you still do the old-fashioned RPG technique of telling one person to go here or there, with the rest of your four-person party following in step. Your two characters interact frequently, which makes for a bit of a surrealist moment when you go to decide what each says to the other (and how their relationship ultimately unfolds). Those of you who don't like talking to yourself will likely prefer the game's AI options for conversations.

If you're creative, you can make this interaction work even better for you. We often enjoyed "decoupling" our four-person party and having three stand in front of an important NPC and hold its focus while the fourth, our expert thief, looted everything in the room that wasn't bolted down. No, we weren't actually playing the game as an "evil" party. However, massive thievery—art theft, specifically—is one of the major ways to quickly earn cash in the game.

Baldur's Gate, this ain't. Don't expect to go steamrolling through crowds of baddies with no issues whatsoever, amassing all sorts of loot and unique weaponry along the way. First off, the game's combat is completely turn-based. Battles take time. Each character in combat has initiative, which determines in what order they fight throughout combat—we completely missed the "delay turn" button on the right side of the game's screen, which might have come in handy during some of our tougher tactical encounters.

About those. We found *Divinity: Original Sin* to be a bit tough. We're not quite sure if it's the game's turn-based aspect, the makeup of our party, or what. It *was* a bit annoying to roll a fighter/tank as one of our main characters, only to receive a free fighter/tank as the first of the two total NPCs that can join your travelling party. But, we didn't figure that would be a huge detriment as we progressed our way through the early stages of the game.

We were wrong.

This is definitely an area that developer Larian Studios needs to address with player character DLC packs (or free add-ons), as message board post after message board posted seemed to indicate that our party makeup was ill-advised. We felt the effects of that in one of our first major battles outside of the game's "first act" city of Cyseal, where we were thoroughly decimated by a

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Perhaps a paring-down of some of the items within the game might have been better....

party of eight-to-ten undead creatures. Reload. Decimated. Reload. Decimated.

We eventually got past our predicament by running through every side quest we could find in an attempt to level our characters as much as possible prior to heading out once more. We also turned to the game's unstable economy—namely, the ease at which one can steal fairly expensive items and barter them with anyone around—to outfit our folk with as much fancy gear as we could (but shouldn't be able to) get our hands on. Nevertheless, having a combat roadblock so early on in the game did sap some of its fun, and might very well have overtaken our interest in continuing forward were we not reviewing the title.

In outfitting our party, we were forced to deal with the game's fairly cumbersome UI. Those familiar with the aforementioned isometric RPG titles (or role-playing games in general) should know the deal by now: drag-and-dropping gear onto your paper doll characters from your semi-chaotic inventory, et cetera. Since *Divinity: Original Sin* allows for co-op multiplayer, that means that Larian Studios has decided to treat all of your characters as if they are separate individuals, inventory-wise.

For solo gamers, inventory management is a huge pain in the butt. Only one character's inventories can be used to barter with merchants at once, and gold reserves are individual to each character (no group "gold account," as is typically seen in multi-character RPGs). This forces you to frequently exchange your sellable goods between multiple characters as you're going about the buying process. You can't do this by dragging-and-dropping items onto character portraits; you have to right-click each item and "send it" to a particular character.

Even the bartering process itself is irritating. If you could only just quick-sell items in your inventory (*Diablo*-style) by right-clicking on them when talking to a merchant. To transact anything in the game, you have to move the items you want to "sell" to the left-most portion of the bartering window. You then click the items you want on the other side.

We spent a good chunk of our game using a merchant's "gold" icon and a slider to set an exact price for our goods. We appreciate the manual control, but didn't realize that the "scales" icon in the game's bartering window would do that for us until we completed far too many transactions.

While we appreciate that *Divinity: Original Sin* doesn't hold one's hand that much as far as questing goes, we would have preferred a little more help for navigation. Some buildings are marked on your map when you uncover them, but not all. A pin-drop quest marker only shows you where you might want to go for the main story quest. Your logbook-slash-journal keeps records of what you've been up to, like most typical RPGs, but it isn't always crystal-clear about how to finish up some side quests, nor where you might want to start looking if you haven't even uncovered much of the map. Going door to door to find key characters and locations seemed to take forever in the early part of the game.

We greatly enjoy *Divinity: Original Sin*'s treatment of the environment, however. The game constantly encourages you to monkey around with everything around you, be it throwing and exploding barrels filled with flammable gunk, rearranging furniture to find hidden buttons for secret rooms, or bashing down locked things that, in other games, would require the delicate touch of a thief to get past. We often found ourselves looking at combat with much more strategy in mind than we would other titles; of course, as we mentioned, we still had a tendency to get beat up.

Divinity: Original Sin is hardly a flawless title. Its single-player annoyances might turn gamers off at first, but its creativity, challenges, and puzzles are worth pushing toward. This isn't the game we'd give to RPG newcomers, but veterans will appreciate the good that comes with the bad—especially if a few patches fix up some of the title's quirks

–DAVID MURPHY

VERDICT **6**

Divinity: Original Sin

+ MR. SINISTER Fairly complex RPG offers a good challenge; hands-off approach for RPG veterans; heavy focus on environmental gameplay.

– SINSTAR Awkward inventory management and bartering system; more NPC companions needed; thievery becomes economy's Achilles' Heel.

$40, www.divinityoriginalsin.com, ESRB: M

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LAB NOTES

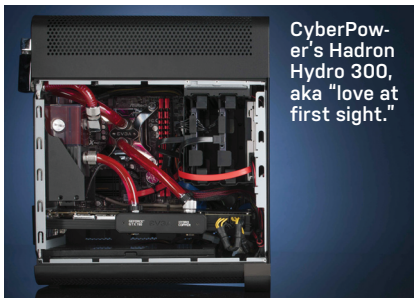
ALAINA YEE **MANAGING EDITOR**

This Is Our Fork in the Road

A year full of new adventures

ABOUT TWO YEARS AGO, when I still worked for one of *Maximum PC*'s sister magazines, I approached Gordon in our office kitchen for the first time—I wanted to chat about some ideas I had about benchmarking an Xbox 360 peripheral I was considering for review. Never did I imagine that the subsequent conversations about computer components and my drive-by ogling of the most gorgeous hardware I've ever seen would lead to a job among writers and editors I admired greatly from afar.

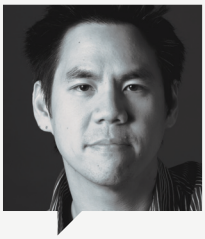
I also hadn't foreseen the life changes that'd take me on a different path just a few months after starting at *Maximum PC*. But how full these days here have been! Not only have I absorbed an incredible amount of new knowledge and updated my mental databanks on specs, parts, and cases, but I've also come to look forward to the casual, daily razzing from the rest of the crew. It's been a steady stream of cracks about PC gaming being superior (not that I've ever disputed its advantages; a gal just has certain preferences, sometimes)—but I managed to one-up Gordon and Tom at one point by plugging an HDMI cable into a Build It's integrated graphics, and then innocently asking why FRAPS was showing such a low fps rate in *ACIV*. Took 'em awhile to figure it out.



CyberPower's Hadron Hydro 300, aka "love at first sight."

But as fun as it's been to learn the fine art of trolling your coworkers without making them actually hate you, the biggest joy I've had in my time here has been getting to know all of you. I never envisioned having the great fortune to serve such a singularly kind, welcoming, and dedicated readership. Be it the Facebook and YouTube comments, or letters to the editor, it's been such a pleasure to see such shining enthusiasm for pure PC power. No petty bickering or disparaging slams—you love what we love just as much as we do. We're all of one mind. Thank you so much for your support of the magazine.

You won't be rid of me just yet—I'll still be lurking as a contributor. For that, I'm grateful. I'm not ready to say good-bye to everyone.



JIMMY THANG

Online Managing Editor

With this month's Eurocom M4 running a 3200x1800-resolution display, I had my first chance at sinking my teeth into an ultra HD (UHD) panel. From this experience, I can confidently say that the laptop market is not ready for UHD resolutions. First off, there's simply not a lot of UHD video out there, and I don't expect this to change anytime soon. Secondly, expect to run into tons of scaling issues, in which programs look either really soft or tiny. The final hurdle is that mobile GPUs simply are not yet powerful enough to run today's games at those resolutions. I would hold off on paying the premium for an UHD display, especially on a laptop.

TOM MCNAMARA

Associate Editor

While building a PC is a lot like sticking Lego pieces together, there are all kinds of little details that come to mind when you stop to think about it. Deciphering proprietary drive trays, routing cables out of sight, pointing fans in the right direction, things like that. I had a lot more space to write about this stuff for this month's cover story than I usually do with Build It, but it still wasn't enough for all the miscellaneous but important trivia. The best way to do it may just be an instructional video instead. On the other hand, this magazine doesn't need a battery.

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First Look: Shield Tablet

Introducing Nvidia's 8-inch gaming tablet, powered by Tegra K1

AFTER MANY RUMORS of a new Shield device, Nvidia has revealed its new Shield Tablet. Powered by Android, the 8-inch gaming tablet succeeds Nvidia's original Shield gaming handheld, which has been re-dubbed the Shield Portable.

At the heart of the Tablet is the company's new top-tier mobile SoC, the Nvidia Tegra K1. The quad-core ARM chip features 192 CUDA cores with a 2.3GHz max clock speed. K1 supports a variety of APIs and features, which include OpenGL ES 3.1, AEP, OpenGL 4.4, DX12, Tessellation, and CUDA 6.0. Nvidia claims that the K1 can do all of this while consuming less than two watts of power.

For the display, the Shield Tablet uses a 1900x1200-resolution IPS panel. Content-wise, Nvidia has created a new Shield hub that allows you to access your game library, purchase more games, or launch other media apps. You'll also be able to stream PC games through the hub. The Shield Tablet will support both Nvidia GameStream for local PC streaming and Nvidia Grid for remote streaming. In addition, Nvidia has partnered up with Twitch to allow you to stream your Shield gameplay sessions to the social gaming site.

Of course, all of this wouldn't sound the least bit appealing if you didn't have a controller to game with (because playing real games with tablet controllers is just... eww.). Luckily, the Shield Tablet is not only compatible with Bluetooth controls, but Nvidia is also making a new Wi-Fi Direct controller for the device. The company claims that the Wi-Fi Direct has 2x lower latency than Bluetooth and offers more bandwidth. What will this extra bandwidth allow you to do? For starters, you'll be able to plug a headphone into the controller. Secondly, you'll be able to connect up to four Shield controllers to the Tablet. This is ideal for when you plug the Shield Tablet into your HDTV via HDMI while in "Console Mode."

While you could use the device as a console of sorts, it is first and foremost a tablet. If you're out and about watching movies, Nvidia says you should expect 10 hours of battery life. Five to six hours is what the company claims you should be able to get out of the device when gaming.

We found the device's thermal setup particularly interesting. Unlike the first Shield, which used fans for active cooling, the Shield Tablet is passively cooled. To get away with this, Nvidia installed a thermal shield (pun not intended) to dissipate more heat. This adds about a millimeter of thickness to the device, but fortunately, the Shield Tablet isn't unbearably thick to begin with.

Other features of the device include two 5MP cameras (one on the front and one on the back), an included stylus, an SD card slot, and support for 4K output at 30FPS.

In terms of pricing, the Shield Tablet will come in two flavors. The 16GB version will retail for $299, and the 32GB LTE version will retail for $399. Unfortunately, the controller will be sold separately and will retail for $59. In addition, there will also be a $39 Shield Tablet cover, which can also act as a stand.

The Shield Tablet launched on July 29th in the United States and Canada, will release in Europe mid-August, and other regions in the fall. **–JT**

The Wi-Fi Direct controller will have 2x less latency than traditional Bluetooth controllers.

GEEK TESTED & APPROVED

Roccat Tusko

NO LAPTOP WILL EVER fill the shoes of a small form factor gaming PC, it's absolutely no fun to lug around your system and monitor. Enter Roccat's Tusko. Designed to safely envelop your monitor—it'll fit 20- to 24-inch panels, with a smaller version handling 15- to 19-inch screens, too—and has straps for your keyboard as well as pockets for a mouse and cables. Among the features we really appreciate are the side straps that keep the monitor from slipping out. Believe it or not, not all monitor carriers have these straps. We also recognize that while not everyone needs to go places with a monitor, the Tusko is a great way to protect monitors you have kicking around your home or office. No joke, we've literally destroyed three monitors that were sitting in a closet or on the floor because something struck the LCD. A Tusko with its hard cover would have saved them. Roccat Tusko $65; www.roccat.org **–GU**

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LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Where's Save Anywhere?!
> Are You Sure About Norton?
> Word Nerd Battle

Right On

Tom, thanks for the great *Wolfenstein* review—particularly for pointing out something no one talks about: crappy checkpoint saves. I am righteously pissed about this. What the hell ever happened to Save Anywhere? Fewer and fewer games offer it. I threw in the towel on *Borderlands 2* after it forced me to replay the same damn stretches one too many times; and even formerly reliable Bethesda games seem to have gone checkpoint-only. *Assassin's Creed IV* even has a "cheat mode" that would be completely unnecessary if they only allowed us to save whenever we want. Outrageous! So I'm glad you mentioned the checkpoint save system in *Wolfenstein*—I won't buy it, nor any other game that does not RESPECT MY TIME.
—James Cirile

It's Really Not That Bad

I'm a long-time reader of *Maximum PC*, and for good reason: I love having the latest and greatest. When the i7-980X first came out, I was lucky enough to be able to splurge and get it. But that bad boy is four years old now, and I've passed on Sandy Bridge and Ivy Bridge. Now that Haswell is out, I'm champing at the bit to upgrade again. Now, mind you, my i7-980X is still pretty darn fast. But I don't do too much video editing, and prefer the faster Haswell for gaming. Plus, the power/heat efficiency of Haswell is nice, too.

The major thing keeping me from upgrading? DRM. I hate the idea of having to re-validate my Win7 OS, then my NIS software, then my Storagecraft Shadowprotect backup software, Steam, and all the other DRM-laden crap I've accumulated over the years. I'd have to track down all the de-authorization/de-installation procedures for each software title, and figure out how to transfer those licenses to the upgraded PC. What a royal !@#$!*

Am I the only one? Or is DRM really holding back the PC industry for DIY upgraders like myself? **—Gary Pien**

EDITOR-IN-CHIEF GORDON MAH UNG RESPONDS: I feel your pain, Gary, but I wouldn't blame just the DRM aspect. It's certainly one of the reasons people don't like to replace systems, but I'd argue that it's more the problem of actually having to reinstall the software, download drivers for peripherals (scanners, printers), and move all of your personal files without the fear that you just lost a year of photos because you didn't back them up before installing over the drive. I also tend not to want to upgrade because there's always some application that doesn't work with the newer OS or newer hardware but that I desperately need to use two years later. For a lot of people, moving to a new system is about as traumatic as moving your home. It's just a lot of crap to migrate.

I don't want to downplay your concern, though. There are some applications that actually don't allow you to reinstall on a new machine without contacting them for a new code, and some games (e.g., *Batman: Arkham City*) that actually had limited installs, period. You had limited installations and limited deactivations, so eventually the game simply stopped working. OK, maybe you've convinced me—it is DRM's fault.

How Times Have Changed

As I was reading your evaluation of the various antivirus programs, I was surprised to see Norton Internet Security with a good rating. From what I've heard from several people I work with, Norton has questionable long-term effects on a PC. Could you confirm/deny these allegations, please?
—Zach Baker

EDITOR IN CHIEF GORDON MAH UNG RESPONDS: Norton's bad rep came from older versions of it. Five years ago, Norton was considered horrible—just like McAfee. Symantec did a complete rewrite, though, and its current impact on performance is very low. I know what you're talking about, though, because when Paul did the review on Norton and I saw it scored "not horrible," I didn't believe him. I had to get a copy to try out.

I have actually used Kaspersky for some time but just switched over to Norton because the updates on Kaspersky kill me in their speed. I also switched my father-in-law over from McAfee to Norton and it was like night and day.

So, yeah, I understand your skepticism, but Norton's a pretty good product these days.

↘ submit your questions to: comments@maximumpc.com

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Where You Say "Contravenes," Perhaps Change to "Violates"?

While reading the Dream Machine 2014 article in the September 2014 issue, I came across a sentence I was just not able to parse: "In the end, we declared that our desk space (literally) and the reality of 4K surround today (it's a pain) meant we'd have to tap on an old friend: the ASUS PB321Q." I've read that sentence several times, but can't make sense of it. Do you mean, you possess actual (not figurative) desk space, and, because 4K sound is real on this day (but illusive on others?), and inflicts pain, you need to "tap on" (usually it's just "tap", as in, tap a shoulder to select someone for service) the ASUS PB321Q monitor? Does the ASUS PB321Q video monitor possess spacetime-warping and analgesic qualities?

I know that the language evolves, and "literally" does not mean what it used to mean. But I am concerned that many writers today use the word in a way that harms trust between writer and reader. I think "literally" is a way to display one's lack of trust in one's readers. It is an easy way to inflate the import of one's news. It is imprecise. It is a tool of marketers. And—sorry—I feel that your use of the language of marketers contravenes your stated Minimum BS policy.

There are other places in your magazine where a writer emphasizes a point with "literally." In every place, I stumble and think: why? Is there not a simpler, minimum-BS way to write this sentence? I wonder if you would consider an editorial policy: omit "literally" from all stories. I think if you committed to that policy, then your stories would gain clarity and power. And maybe spacetime-warping and analgesic qualities, too.
—Eric Bourland

MANAGING EDITOR ALAINA YEE RESPONDS: All right, everyone who's not a writer, editor, or generally obsessed with diction should clear out now. We'll get back to discussing computer parts shortly.

I'm solidly in your camp on the current misusage of the word "literally," Eric. However, in the case of this particular (and somewhat gnarly) sentence, Gordon used the word correctly.

The real problem is that there are some missing words in the sentence, and its structure isn't as clean as we like to see in our final articles. If we had said, "In the end, we decided that the combination of our literal desk space and the painful reality of 4K surround today meant we'd have to tap an old friend: the ASUS PB321Q," I think you'd be able to parse the sentence a bit more easily.

As for the use of "reality," the word means "the true situation that exists; the real situation" or "something that actually exists or happens." (Source: m-w.com) Also, it's a colloquialism to use "today" to stand in for "currently." So, if I were to swap in "state" for "reality" and "current" for "today," that might better satisfy your particular guidelines for how to structure a sentence, but then that's just a standard editor-writer argument. And no one ever truly wins those.

[NOW ONLINE]

GRAPHICS PORN: SHOWCASING SCREENSHOT ARTIST K-PUTT

Let's face it, if you're not playing beautiful PC games, you're not taking full advantage of your beastly GPU. To showcase some of the prettiest games out there, we're running an ongoing feature on MaximumPC.com called "Graphics Porn." It's an article where we take your best game screen-cap submissions and showcase them for the world to see. This month, we looked exclusively at screenshot artist K-putt's work. Check out the online story for some of the most beautiful shots of *Crysis 3*, *BioShock*, and *Dear Esther* you'll ever see. http://bit.ly/MPC_gporn

Facebook Polls

Why Do You Build PCs?

Like with most things in life, there are different reasons that motivate us to put together our own rigs. We asked those of you on Facebook to share just you put up with the highs and lows of DIY builds. Here are our favorite responses.

Jonathan Lowe: The PCs I build behave better than those I have bought. They know I brought them into this world; I can take them out.

Scott Welborn: I do not build PCs. I build sleeper cell units to be utilized by the mighty Skynet upon its awakening.

Jesse Kreis: Building friends is better than buying them.

Chris Grose: For the satisfaction of understanding the details of the most complex thing mankind has ever created—the computer.

Dave Brown: Artistic expression / control over your own parts / quality of parts / it's awesome to do / believe it or not, pleases the gamer wife.

Zhenya Klatt: You get to choose the exact parts you want. Best moment of it when you assemble everything and it powers on first try.

Kamel Kamel: Because I don't have a life.

Chris Gerrish: Therapy.

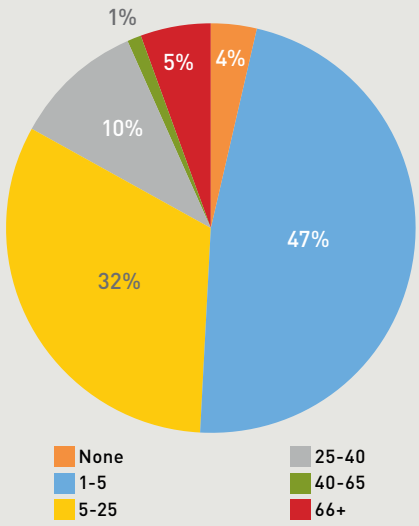
Mike Whatley: Because Lego is a damn sight less comfortable to stand on...

Heather Warnock: Because they don't have a Burger King with a PC store in it... and I want it MY WAY!

Matt Kearns: Building mountains of debt wasn't working out.

Nerot Perks: I owned two Dells in the past.

How Many PCs Have You Built?



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THE BUILDS

BUDGET

INGREDIENTS

PART			PRICE
Case	NZXT Source 210 Elite		$50
PSU	Corsair CX500 500W		$30
Mobo	Biostar TA970		$60
CPU	AMD FX-6300		$110
Cooler	Cooler Master Hyper 212 Evo		$36
GPU	Sapphire Radeon R7 265		$153
RAM	2x 4GB Crucial Ballistix Sport DDR3/1600 BLS2K4G3D1609ES2LX0	NEW	$77
SSD	256GB Crucial MX100	NEW	$110
HDD	1TB Seagate Barracuda		$65
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $791

YOU COULD DROP THE SSD and get a nicer video card. If that's your preference, we'd recommend a Radeon R9 280, or a GeForce GTX 760. We prefer having an SSD, because it makes booting Windows and loading programs super fast. The huge data-transfer speeds (up to 550MB/s in some scenarios) aren't bad either. We've bumped our SSD up from a 128GB Samsung 840 Evo to a 256GB Crucial MX100, because you double your capacity for about $30 dollars. Other than that, we think we have a pretty good balance of price and performance. Some people might scoff at a $50 case, but the Source 210 Elite is actually surprisingly sturdy and roomy for the price. We've changed our RAM due to price fluctuations.

MID-RANGE

INGREDIENTS

PART			PRICE
Case	Corsair Vengeance C70		$108
PSU	EVGA 220-G2-0850-XR 850w	NEW	$100
Mobo	Gigabyte G1.Sniper Z87		$175
CPU	Intel Core i5-4690K		$240
Cooler	Enermax Liqtech 240	NEW	$95
GPU	Sapphire TRI-X OC Radeon R9 290	NEW	$400
RAM	2x 4GB G.SKILL Ares Series DDR3/1600		$72
Optical Drive	Samsung SH-224DB/BEBE		$20
SSD	Crucial MX100 256GB	NEW	$110
HDD	Seagate Barracuda 3TB ST3000DM001	NEW	$95
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $1,515

WE'RE SHAKING THINGS UP A BIT and bumping this tier up from about $1,200 to $1,500. That allows us to squeeze in a nice closed-loop liquid cooler like the Enermax Liqtech 240 (scored a 9 in our August issue), upgrading from the Cooler Master Hyper 212 Evo (which is still a very nice air cooler). We also upgraded from a Radeon R9 280X to a Sapphire Tri-X OC Radeon R9 290. The 280X is a refresh of the last generation, while our 290 GPU is based on all-new silicon. We've changed our power supply from Silverstone to EVGA to accommodate price fluctuations. Previous EVGA PSUs had split 12-volt rails, while its newer units are unified. The latter design makes it easier to deliver lots of power to high-end gear.

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TURBO

WE ARE BUMPING THIS TIER UP from about $2,000 to $2,500, and we're doing away with the roughly $4,000 "Ultra" build for now. We're not changing very many things, though. The Intel Core i7-4790K is a muscular and well-rounded chip, and 16GB of RAM is for multitaskers and virtual machines. One change is the CPU cooler. We want to use the NZXT Phantom 530 case's sheer size. That's where the NZXT Kraken X61 comes in. Its 280mm radiator can dissipate heat more quickly than the 240mm rad of the Corsair H100i that we're replacing. The X61's larger fans also move more air with less noise, and its six-year warranty is also a nice bonus.

The other big change is going from one Radeon R9 290X to two Sapphire TRI-X OC Radeon R9 290s. AMD had issues with microstutter in the past when running multiple video cards, but that's mostly solved now. Since a 290 is roughly equal to an Nvidia GeForce GTX 780, two 290s can scale all the way to 4K gaming.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best.

INGREDIENTS

PART			PRICE
Case	NZXT Phantom 530		$130
PSU	XFX P1-1050-BEFX 1050W		$180
Mobo	Gigabyte GA-Z97X-UD5H		$175
CPU	Intel Core i7-4790K		$340
Cooler	Kraken X61	NEW	$140
GPU	2x Sapphire TRI-X OC Radeon R9 290	NEW	$800
RAM	4x 4GB G.SKILL Ripjaws F3-12800CL9Q 16GBRL		$150
Optical Drive	LG WH16NS40 Blu-ray Burner		$70
SSD	Samsung 840 EVO 500GB MZ-7TE500BW		$250
HDD	Seagate Barracuda 3TB ST3000DM001		$100
OS	Windows 8.1 64-bit OEM		$100

Approximate Price: $2,435

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$300, www.steelseries.com

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